THE SOUTH AFRICAN MUSEUM'S *MEIRING NAUDE* CRUISES
PART 9
BRYOZOA

By

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(With 21 figures, 4 tables, 1 appendix)

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ABSTRACT

Bryozoa from the hitherto uninvestigated deeper shelf waters (>350 m) off the eastern South African coast are both abundant and diverse. A total of 1 Ctenostome, 2 Cyclostome and 48 Cheilostome species is described. Of these, 23 species—*Carbasea mediocris, Notocoryne cervicornis, Notoplites cassidula, N. candoides, Tricellaria varia, Bugulella australis, Cellaria tectiformis, C. paradoxa, Aspidostoma magna, Inversiscaphos setifer, Escharoides distincta, Flustramorpha angusta, Adeonella majuscula, A. cracens, Tessaradoma bispiramina, T. circella, Sertella bullata, Reteporella dinotorhynchus, R. clancularia, Turbicellepora protensa, Costaticella carotica, Batopora lagaaiji* and *B. nola*—are considered to be new. In addition, 3 new genera—*Notocoryne, Leiosalpinx* and *Inversiscaphos*—and 1 new family, the Setosellinidae, are introduced. Some species have previously been described from regions as far distant as the Eastern Atlantic and Western Pacific Oceans, and are known from very few records. Of the 22 previously reported species, 14 are new records for South Africa, and 4 for the Indian Ocean. Many of the colony growth forms (morphotypes) of species are known to be adapted to life on the surface of fine sediments, and are either anchored by rhizoids or 'free-living'. Most colony morphotypes are flexible and delicate, and some are extremely small, less than 3 mm in diameter.

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INTRODUCTION

Bryozoa are generally most abundant in the shallow waters of continental shelves, where firm substrata are available for larval settlement and colony growth (Ryland 1970). Recent work on the faunas of the deeper waters of the Atlantic and the outer shelf and slope of western Europe has, however, revealed a far greater abundance of colonies and diversity of species than previously recorded (D'Hondt 1975*a*, 1977; Hayward 1977, 1978*a*; Hayward & Ryland 1978). The substrata available for colonization in some of these regions often consist only of the fine sea-bottom sediments. Species therefore tend to show adaptations of structure which enable them to live in this environment.

The bryozoan fauna described here, from seventeen of the *Meiring Naude* stations, with depths ranging between 376 and 1 300 m, resembles those from western Europe in showing a remarkable diversity of taxa and colony growth forms. A high proportion of the species does not appear to have been described before, and many of the previously described species have extensive geographical ranges, often with equally broad bathymetric distributions. The occurrence of numerous colonies of very small 'rooted' or 'free-living' species in the bottom sediments is particularly interesting, and these collections have provided a great deal of information, not only on the South African Bryozoa, but on the potential nature of deep-water faunas from other regions.

LIST OF SPECIES

The *Meiring Naude* collections comprised 51 species of Bryozoa: 48 cheilostomes, 2 cyclostomes and 1 ctenostome. In Table 1 the species are listed in systematic order, and their occurrence at each of the seventeen stations indicated. The stations are arranged in order of increasing depth, and the sediment type and total number of species recorded is given for each station. Co-ordinates and depth for the *Meiring Naude* stations which yielded samples of Bryozoa are listed in Appendix 1. Data for all stations are given by Louw (1977).

SYSTEMATIC ACCOUNT

ORDER CHEILOSTOMATA

Family **Cupuladriidae** Lagaaij, 1952

Cupuladriidae Lagaaij, 1952: 31. Cook, 1965*a*: 154; 1965*b*: 192.

Discoporella d'Orbigny, 1852

Discoporella d'Orbigny, 1852: 472. Cook, 1965*b*: 219.

Discoporella umbellata (Defrance, 1823)

Lunulites umbellata Defrance, 1823: 361, pl. 47, fig. 1a–b.
Discoporella umbellata: Cook, 1965*a*: 177, pl. 1 (fig. 7), pl. 3 (figs 1, 3, 5–6), fig. 4; 1965*b*: 221, pl. 3 (fig. 3), fig. 2h.

Material

Stations SM 23, SM 31.

Description

Colonies lunulitiform, free-living. Zooids with an extensive cryptocyst lamina, perforated by opesiules; opesia small. Basal surface of colonies grooved. Avicularia regularly patterned, each distal to a zooid; mandibles setiform, slung from asymmetrical condyles.

Remarks

Two small, worn colonies only, which may have been transported from shallower water, were found.

Family **Setosellinidae** fam. nov.

Colony encrusting very small substrata, often becoming free peripherally. Ancestrula single, budding two primary zooids and two avicularia directly. Zooids in two series, budded spirally for at least the first four astogenetic generations. Avicularia interzooidal, one placed distally or distolaterally to each zooid; subrostral chambers rounded, inflated. Mandible setiform, slung from asymmetrical condyles. Brooding zooids with dimorphic, wide opercula, embryos brooded in a large ovicell with a central, distal foramen, closed by the operculum.

Genera included: *Setosellina* and *Heliodoma*.

The genera *Setosellina* Calvet and *Heliodoma* Calvet share a correlation of distinctive colony form, spiral budding pattern and type of zooidal polymorphism. Some species of *Setosellina* appear, however, to be similar to encrusting membraniporine forms which have no distinctive budding pattern, but which are assigned to different families. A parallel group of deep-water coilostegan species (the Setosellidae) which display a similar range of colony form, but with zooids with distinct cryptocyst laminae and opesiules, has, however, long been given family status. A family group is therefore introduced here for the genera *Setosellina* and *Heliodoma*.

Setosellina was placed in the Hincksinidae by Lagaaij (1963*b*) and Cook (1965*a*). The type species of this heterogenous group, *Hincksina flustroides* (Hincks), is now usually assigned to the Flustridae (Ryland & Hayward 1977: 86). *Setosellina* has also been included in the family Lunulariidae, another diverse and artificial grouping, which included the Cupuladriidae (Prenant & Bobin 1966: 297), and the Selenariidae (Cheetham 1966: 24). The free-living members of the Cupuladriidae and Selenariidae differ from the Setosellinidae in possessing a basal, colony-wide coelomic cavity (Håkansson 1973).

The genus *Vibracellina* Canu & Bassler (1917: 14) includes fossil and Recent species which may prove to be attributable to the Setosellinidae. *V. laxibasis* Canu & Bassler, a Pliocene species from Panama which was discussed by Lagaaij (1963*b*), and *V. viator* Canu & Bassler (1929: 97), a Recent

TABLE 1

List of species collected.

Depth	500 m >										750 m >				1 000 m >			No. of	Morph.	
Station	16	23	85/86	69	92	103	67	1	53	32	31	78	60	61	41	107	109	stations	type	Rhizoids
Discoporella umbellata		×									×							2	L	
†*Setosellina roulei*	×		×	×		×		×									×	6	S	
†*Heliodoma implicata*	×	×	×	×		×		×			×		×	×	×			10	S	
**Carbasea mediocris*			×															1	F	
**Notocoryne cervicornis*	×		×					×	×	×			×		×			7	Co	(R)
Notocoryne cylindracea	×														×			2	Ca	R
**Notoplites cassidula*		×	×										×					3	Ce	R
**Notoplites candoides*		×																1	Ce	R
**Tricellaria varia*						×												1	Ce	R
Eupaxia quadrata	×				×	×												3	Ce	R
**Bugulella australis*	×	×	×							×								4	Ce	(R)
Leiosalpinx inornata																×		1	Ce	(R)
Columnella magna							×											1	Ca	R
Nellia sp.													×					1	Ca	R
†*Petalostegus bicornis*								×								×		2	Ce	(R)
**Cellaria tectiformis*	×	×	×			×		×							×			6	Ca	R
**Cellaria paradoxa*			×			×		×										3	Ca	R
**Aspidostoma magna*		×													×			2	A	
Figularia philomena	×														×			2	M	
**Inversiscaphos setifer*	×																	1	S	
**Escharoides distincta*	×	×																2	M	
Flustramorpha marginata		×													×			2	F	R
**Flustramorpha angusta*	×																	1	F	R
Gigantopora polymorpha						×												1	A	
Adeonella coralliformis	×		×												×			3	A	
**Adeonella majuscula*			×												×			2	A	
**Adeonella cracens*		×	×												×			3	A	
Adeonella sp.	×					×									×			3	A	

Smittoidea ?hexagonalis			×															1	M	
**Tessaradoma bispiramina*		×	×			×												3	A	
**Tessaradoma circella*	×		×		×	×												4	A	
**Sertella bullata*	×	×													×			3	R	
**Reteporella dinotorhynchus*		×													×			2	R	
**Reteporella clancularia*		×													×			2	R	
**Turbicellepora protensa*		×	×			×									×			4	R	
?Turritigera sp.	×	×																2	A	
**Costaticella carotica*	×	×	×															3	Ce	(R)
Anoteropora latirostris	×	×																2	L	(R)
Anoteropora inarmata									×				×					2	L	R
Batopora murrayi	×	×	×						×	×		×	×					7	Co	R
**Batopora lagaaiji*	×			×					×		×		×					5	Co	R
**Batopora nola*	×	×	×												×			4	Co	R
Lacrimula pyriformis	×	×	×					×										4	Co	R
Conescharellina africana	×	×	×					×							×			5	Co	(R)
Trochosodon sp.													×					1	Co	R
?Neoflustrellidra sp.			×															1	Ca	
Idmidronea atlantica			×															1	A	
Crisia aff. *holdsworthi*													×					1	Ce	(R)
No. of species	23	23	21	3	2	11	1	8	4	3	4	1	11	1	18	2	1			
	VF	F		F		F	F	VF	VF	F	VF	F	MC	VF	MC		F			
	Sh	Gl		Sh		S	S	Gl	Gl	F	Gl	F	F	Gl	F		Gl			

Explanation of Table 1

The species are listed in systematic order, and the stations are arranged in order of increasing depth. New species are marked *, and species new to the Indian Ocean are marked †. Colony morphotypes (see p. 118) are indicated thus: M (membraniporiform), A (adeoniform), R (reteporiform), F (flustriform), Ce (cellulariiform), Ca (cellariiform), Co (conescharelliniform), L (lunulitiform) and S (setoselliniform). The presence of rhizoids is noted thus: R (observed), (R) (inferred). The predominant size of sediment particles is indicated thus: VF (very fine <1,0 mm), F (fine <5,0 mm), MC (medium coarse >5,0 mm), and the dominant type of particle thus: Sh (shell), S (sand), F (benthic foraminiferans with arenaceous test), Gl ('globerigina'—type foraminiferans). The number of species at each station, and the number of stations at which each species was found is also given.

TABLE 1

List of species collected.

Depth	500 m >										750 m >			1 000 m >						
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†*Setosellina roulei*	×		×	×		×		×									×	6	S	
†*Heliodoma implicata*	×	×	×	×		×		×			×		×	×	×			10	S	
**Carbasea mediocris*			×															1	F	
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Notocoryne cylindracea	×														×			2	Ca	R
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Eupaxia quadrata	×				×	×												3	Ce	R
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Leiosalpinx inornata																×		1	Ce	(R)
Columnella magna							×											1	Ca	R
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**Adeonella cracens*		×	×												×			3	A	
Adeonella sp.	×					×									×			3	A	
Bifaxaria ?mucronata													×					1	Ca	R
†*Bifaxaria ?longicauda*											×							1	Ca	R
Cleidochasma protrusum		×													×			2	M	
Smittoidea ?hexagonalis			×															1	M	
**Tessaradoma bispiramina*		×	×			×												3	A	
**Tessaradoma circella*	×		×		×	×												4	A	
**Sertella bullata*	×	×													×			3	R	
**Reteporella dinotorhynchus*		×													×			2	R	
**Reteporella clancularia*		×													×			2	R	
**Turbicellepora protensa*		×	×			×									×			4	R	
?Turritigera sp.	×	×																2	A	
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Anoteropora latirostris	×	×																2	L	(R)
Anoteropora inarmata									×				×					2	L	R
Batopora murrayi	×	×	×						×	×		×	×					7	Co	R
**Batopora lagaaiji*	×			×					×		×		×					5	Co	R
**Batopora nola*	×	×	×												×			4	Co	R
Lacrimula pyriformis	×	×	×					×										4	Co	R
Conescharellina africana	×	×	×					×							×			5	Co	(R)
Trochosodon sp.													×					1	Co	R
?Neoflustrellidra sp.			×															1	Ca	
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	VF	F		F		F	F	VF	VF	F	VF	F	MC	VF	MC		F			
	Sh	Gl		Sh		S	S	Gl	Gl	F	Gl	F	F	Gl	F		Gl			

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species from the Philippines (41–903 m), are both very similar in colony form and zooidal morphology to *Setosellina*.

Setosellina Calvet, 1906

Setosellina Calvet, 1906: 157; 1907: 395. Cook, 1965*a*: 182.

Ancestrula with one proximolateral primary zooid and avicularium, and one distal primary zooid and avicularium. The two spirally budded series of zooids originating from these zooids surround the ancestrula in either a clockwise or anti-clockwise direction. Intercalary series of zooids budded after the fourth astogenetic generation. Zooids growing free from the substratum peripherally, but rarely protruding for more than two generations. Peripheral avicularia often enlarged and directed basally. Ovicell large, terminal, with a central foramen, closed by a wide operculum.

The earliest known species is *S. gregoryi* Cheetham (1966: 25, figs 4–5) from the Upper Eocene of southern England. The zooids were very small, were budded in anti-clockwise series and had distally placed avicularia. Recent species are associated with fine particled sediments (Lagaaij 1963*b*), from deep water.

The localities given by Calvet (1906, 1907) are based on a meridian passing through Paris, not Greenwich (see Ryland 1969: 238).

Setosellina roulei Calvet, 1906

Figs 1A, 17B, 18B

Setosellina roulei Calvet, 1906: 157; 1907: 395, pl. 26 (figs 5–6).

Material

Stations SM 1, SM 16, SM 69, SM 86, SM 103, SM 109.

Description

Colonies very small (largest—with 34 zooids—3,0 mm diameter). Zooids with basal walls calcified only peripherally, cryptocyst narrow, gymnocyst distinct laterally, variable proximally. Avicularian subrostral chambers large, rounded, placed distally to zooids.

Remarks

Cook (1965*a*) distinguished *S. roulei* from the Mediterranean species, *S. capriensis* (Waters), on the basis of zooidal size as well as bathymetrical and geographical distribution (see also Harmelin 1977: 1062).

The zooids of South African colonies are of comparable size up to four generations from the ancestrula, but attain larger dimensions later in astogeny (see Table 2). Colonies of *S. capriensis* therefore have a similar size range to those of *S. roulei*, but differ in that in *S. capriensis* size decreases with astogeny in colonies which grow beyond the substratum. In addition, the lateral cryptocyst of *S. capriensis* is extensive, and the apertures of the ancestrula and first three zooid generations are closed by a lamina very early in astogeny, when colonies have only twelve zooids. Colonies of *S. roulei* have closed zooids only when more than thirty zooids have been budded, and those affected include only the ancestrula and primary zooid pair, which have slight extensions of the cryptocyst. *S. goesi* (Silén), from the West Indies and Florida, also has zooids with a well-developed lateral cryptocyst (see Lagaaij 1963*b*: 172, pl. 2 (fig. 1), figs 1–2). The zooids are very small and the avicularia budded distal-laterally. Lagaaij (1963*b*) observed that a significant proportion of colonies had anti-clockwise spirals of growth. *S. constricta* Harmer (1926: 264), from the East Indies, differs from all other species in the absence of pore-chambers. The zooids are very small, and have thin lateral cryptocysts and no closed zooids.

Calvet (1907, pl. 26, fig. 5) figured, but did not describe, two zooids of *S. roulei* with large ovicells, each with a small uncalcified frontal foramen. Very similar ovicells have recently been described in *S. capriensis* by Harmelin (1977: 1062, fig. 12).

TABLE 2

Comparative measurements (in mm) of species of *Setosellina* and *Heliodoma implicata*

	Lz	Lap	Lop	lop	ls
Setosellina roulei					
ancestrula	0,25–0,28	0,23–0,25	0,22–0,24	0,17–0,18	
zooid 1	0,30–0,33	0,27–0,30	0,25–0,28	0,18–0,20	0,30
zooid 2	0,35–0,41	0,32–0,33	0,28–0,30	0,18–0,19	0,38
zooid 3	0,39–0,42	0,34–0,36	0,31–0,34	0,19–0,22	0,40
zooid 4	0,40–0,42	0,35–0,36	0,32–0,34	0,23–0,25	0,53
zooid 6	0,43	0,36	0,33	0,25	0,75
zooid 7	0,50	0,43	0,39	0,29	0,75
S. capriensis					
ancestrula	0,25–0,30	0,23–0,25	0,20–0,23	0,19–0,20	—
zooid 1	0,30–0,35	0,27–0,29	0,20–0,22	0,15–0,16	—
zooid 2	0,35–0,41	0,33–0,40	0,30–0,32	0,15–0,17	—
zooid 3	0,45–0,50	0,36–0,39	0,32–0,36	0,13–0,16	—
zooid 5	0,50–0,56	0,40–0,43	0,32–0,35	0,17–0,20	—
zooid 9	0,25–0,28	0,19–0,21	0,17–0,18	0,11–0,13	—
zooid 11	0,22–0,24	0,17–0,20	0,16–0,18	0,10–0,12	—
Heliodoma implicata					
ancestrula	0,20–0,22	0,18–0,19	0,17–0,18	0,15–0,17	—
zooid 1 (lateral)	0,20–0,25	0,19–0,21	0,18–0,19	0,11–0,13	—
zooid 1 (distal)	0,23–0,30	0,20–0,25	0,20–0,21	0,14–0,18	0,40
zooid 2	0,31–0,35	0,25–0,27	0,21–0,23	0,14–0,15	0,43
zooid 3	0,36–0,40	0,25–0,28	0,20–0,21	0,13–0,14	0,50
zooid 4	0,42–0,43	0,27–0,30	0,20–0,22	0,10–0,14	0,68
zooid 5	0,43–0,45	0,28–0,31	0,20–0,21	0,08–0,10	0,83
zooid 6	0,40–0,43	0,30–0,31	0,23–0,25	0,09–0,10	1,10
zooid 11	0,41–0,45	0,28–0,30	0,27–0,29	0,09–0,11	1,30
zooid 20	0,42–0,43	0,29–0,31	0,27–0,28	0,09–0,10	1,40

Nearly all the colonies from South Africa were alive when collected; they have the setiform mandibles intact, and tentacles and viscera are present in all zooids except the ancestrula in specimens with fewer than sixteen zooids. Colonies are far less numerous than those of *Heliodoma implicata* (see below), and show no evidence of larval preference for any particular type of substratum. The size range of sand grains and foraminiferans colonized is 1,00–3,00 mm. The long setiform avicularian mandibles (which reach a length of 0,75 mm) almost certainly have a stabilizing, if not supporting function. They probably also clean the colony surface of deposits, like those of the Cupuladriidae (see Cook 1963) and Selenariidae (see Cook & Chimonides 1978), although the low sedimentation rate in very deep waters makes this an inferred, secondary function.

Distribution

The only previous records of *S. roulei* are from 1 900 m off the Cape Verde Islands, and from 2 330 m off Cap Blanco.

Heliodoma Calvet, 1906

Heliodoma Calvet, 1906: 157; 1907: 396.

Colonies primarily encrusting minute substrata and subsequently becoming free-living. Ancestrula with one proximolateral avicularium, and one distal and one distolateral primary zooid. Two spirals of zooids originate from these zooids, each budded laterally and clockwise, surrounding the ancestrula and alternating with each other. Intercalary zooid series absent. Substratum becoming covered basally by extensions from the basal walls of free-living zooids. Interzooidal avicularia distal. Peripheral avicularian setae supporting colony. Ovicells large, terminal with a central foramen, closed by a wide operculum.

Heliodoma implicata Calvet, 1906

Figs 17A, 18A

Heliodoma implicata Calvet, 1906: 157, 1907: 396, pl. 26 (figs 7–9). Harmelin, 1977: 1063, pl. 1 (fig. 4), fig. 11.

Material

Stations SM 1, SM 16, SM 23, SM 31, SM 41, SM 60, SM 61, SM 69, SM 86, SM 103.

Description

Zooids with well-developed lateral cryptocysts. Ancestrula and primary zooids with thin cryptocysts, which later become extended to form complete closures. Basal walls thinly but completely calcified. Setae of peripheral avicularia very long.

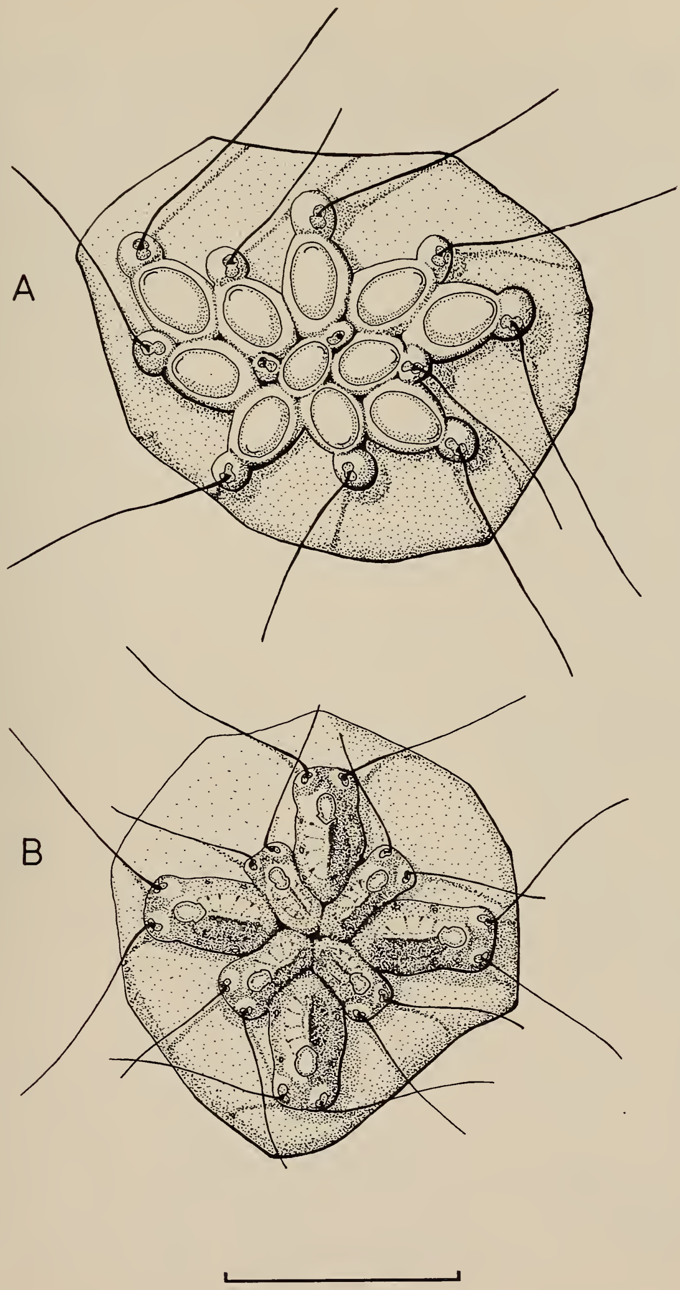

Fig. 1. A. *Setosellina roulei* Calvet. Young colony with setiform avicularian mandibles. B. *Inversiscaphos setifer* gen. et sp. nov. Young colony with paired setiform avicularian mandibles. Scale = 1,0 mm.

Remarks

The differences between *Setosellina* and *Heliodoma* are small but consistent. The early astogeny differs fundamentally (see Fig. 18A–B), and the zooids of *Heliodoma* are always budded laterally. The first primary bud is narrower than the ancestrula (see Table 2) and is laterally budded at right angles; the other primary bud is distal. The pattern figured by Calvet (1907) differs slightly from this, and he did not show any closed zooids. In the South African specimens closures are present in the ancestrula and primary zooids when colonies have six pairs of zooid generations. In larger, older colonies, closures extend to the zooids of the fourth astogenetic generation. Closed zooids have the aperture completely covered by a thick, curved calcified lamina, which has a raised, central umbo, and a faint opercular scar. In contrast, the closures of *S. capriensis* (see above) are flat with a small central pore.

The peripheral setiform mandibles reach 1,40 mm in length and almost certainly have a supporting, as well as a possible cleaning function. None of the colonies is as large as that figured by Calvet, which had 39 zooids. The largest has 34 zooids and a diameter of 2,30 mm. The larvae of *H. implicata* appear to display a distinct preference for fine substrata. Of a total of 221 colonies, 195 grew on sand grains, 22 on foraminiferans, 3 on shell fragments and 1 on a fragment of echinoid spine. The size range of substrata selected ranged from 0,70 mm to 2,00 mm in diameter. Most of the sediments analysed had sand grains abundantly available, except at stations SM 1, SM 16 and SM 69. At station SM 16, shell fragments were dominant, yet of 138 colonies found, none encrusted shell, and 127 grew on sand grains.

Distribution

The original description of *H. implicata* was based on 6 colonies (4 from 1 900 metres off the Cape Verde Islands, and 2 from 3 700 m off the Canary Islands). Recently, 9 more colonies were reported from 200 m from a sea-mount north of the Canary Islands (Harmelin 1977).

Family **Flustridae** d'Orbigny, 1852

Flustridae d'Orbigny, 1852: 324. Smitt, 1868: 357. Ryland & Hayward, 1977: 76.

Carbasea Gray, 1848

Carbasea Gray, 1848: 105, 146. Ryland & Hayward, 1977: 79.

Carbasea mediocris sp. nov.

Fig. 2A–B

Material

Holotype: SAM–A26294, station SM 86, 27°55,4′S 32°40,8′E. 550 m.

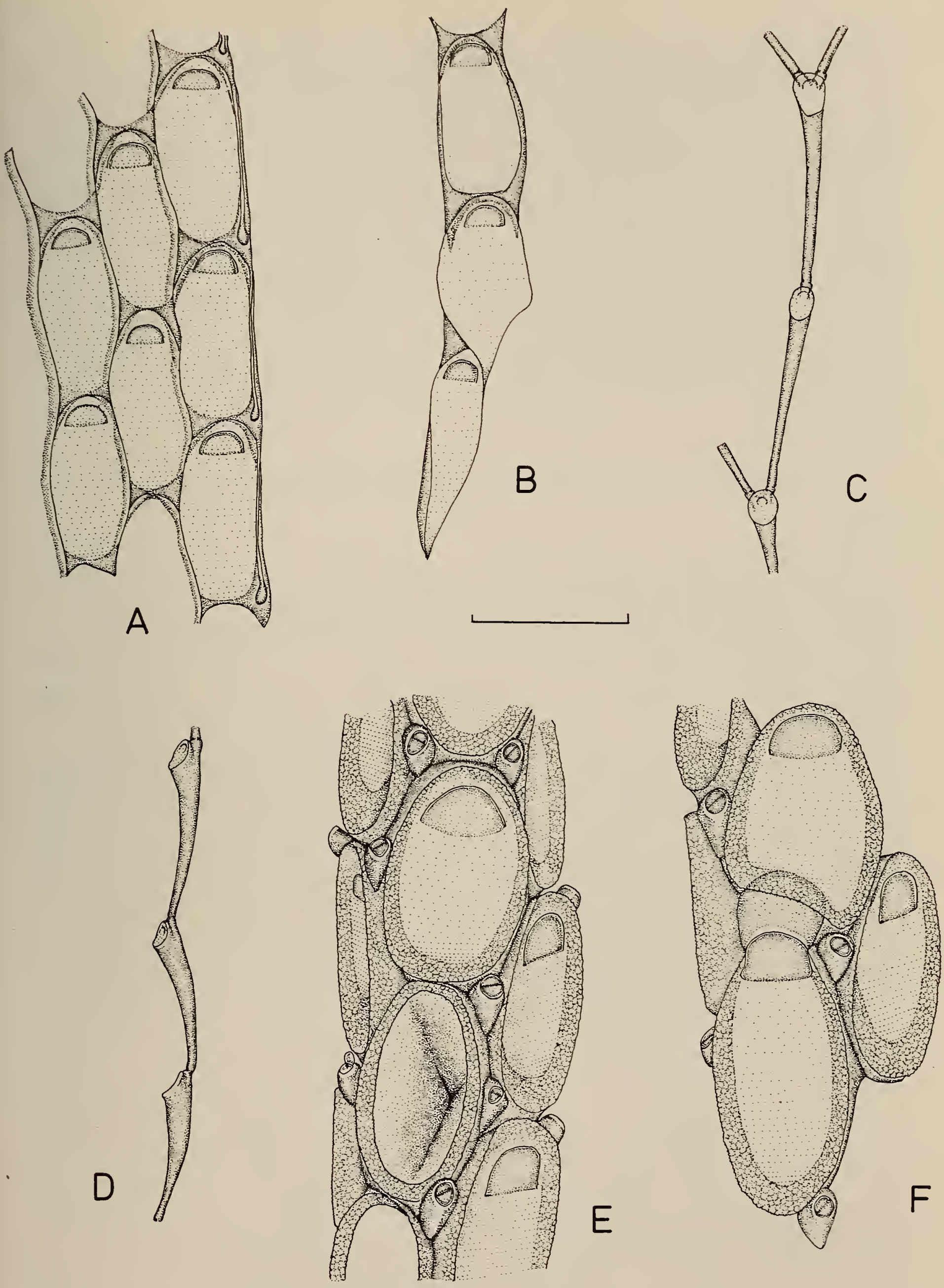

Fig. 2. A–B. *Carbasea mediocris* sp. nov. A. Zooids from the middle of the branch, frond edge on the right. B. The proximal portion of the colony. C–D. *Leiosalpinx inornata* (Goldstein). C. Portion of a colony. D. Zooids viewed in profile, showing joints. E–F. *Nellia* sp. E. A portion of the colony. F. An ovicelled zoοid. Scale = 0,5 mm for E–F; 1 mm for A–D.

Description

Colony forming long and narrow, strap-like fronds, unilaminar, up to 3,5 cm long. Zooids in single, linear series, each series bifurcating infrequently; large, oval or linguiform, distal end rounded, proximal end forked. Very lightly calcified, frontal surface almost entirely membranous, with a scarcely discernible area of gymnocyst over each proximal corner. Operculum subterminal, marked by a thin, shallowly curved sclerite. Adjacent zooids are linked by large multiporous septula in the vertical walls. These linkages are formed between the distal end of the proximal zooid and the forked corner of the distal zooid. At the frond edge, the outer, proximal portion of each zooid may be traced back, along the outer edge of the zooid preceding it, as a slender tube, apparently originating from a particularly conspicuous septulum in the outer proximal fork of that zooid.

Etymology

Mediocris (L)—ordinary, referring to the lack of strongly defined features.

Remarks

One frond had a slender, proximal zooid which was inferred to be the ancestrula. It was tapered proximally, but had no apparent anchoring processes. A single series of five zooids succeeded this assumed ancestrula, the first arose from a septulum in its proximal half, traversing it as a simple tube; disto-laterally, on the opposing side, it budded what appeared to be a simple kenozooid.

Two colonies were collected; in both, all the zooids lacked polypides and a majority contained distinctive brown bodies. The species of *Carbasea* present acute taxonomic problems, arising out of their simplified morphological features. Zooid size and shape are the most useful characters, and in these respects *C. mediocris* is distinct from other known southern hemisphere species. In other members of the Flustridae the form of the colony and the structure of ovicells and heterozooids appear to be valuable characters. The marginal tubular structures seen in *C. mediocris,* which may prove to be kenozooids, have not been described in other species of *Carbasea.*

Measurements (means of 15 values) in mm

Lz	lz
1,05	0,56

Family **Chaperiidae** Jullien, 1888

Chaperiidae Jullien, 1888: 61. Brown, 1952: 94.

Notocoryne gen. nov.

Colony erect, club-shaped or cylindrical, rising from a single elongate ancestrula, secured by rhizoids. Zooids in longitudinal series around the long axis of the colony. Occlusor laminae well developed, occupying the distal third of the opesia. Adventitious avicularia present; spines present, both cylindrical and branched. Ovicell hyperstomial, closed by the zooidal operculum.

Type species: *Notocoryne cervicornis* sp. nov.

The genus *Chaperia*, as presently constituted, includes encrusting, erect foliaceous and vinculariform species; this assemblage may prove to be unnaturally broad. In *Notocoryne* the occlusor laminae are more fully developed than in all species of *Chaperia*, but the principal difference between the two genera lies in the colony form of *Notocoryne*, which implies a degree of morphological integration and adaptation not found in the former genus.

Etymology

Notos (G)—south, koryne (G)—a club, referring to the geographical distribution and shape of the colonies respectively.

Notocoryne cervicornis sp. nov.

Fig. 3

Material

Holotype: SAM–A26303, station SM 86, 27°59,5'S 32°40,8'E, 550 m.

Other material: stations SM 1, SM 16, SM 32, SM 41, SM 53, SM 60, SM 86.

Description

Colony erect, in the form of a slender, faceted club, arising from a single ancestrula but budding rapidly to produce six alternating, longitudinal series of zooids within four astogenetic generations. In the extensive material collected, the largest colonies were 5,5 mm long. Zooids broadly oval or pear-shaped, narrowing distally, 0,5–0,55 mm long by about 0,5 mm broad; zooidal boundary marked by the edges of a broad, flaring cryptocyst, finely granular, gymnocyst reduced and indistinct. Opesia oval, occupying about one half the total zooid length. Occlusor laminae well developed, prominent in the distal half of the opesia in cleaned specimens; fused medially, forming stout junctions with the lateral walls and delimiting two elliptical lacunae for the passage of the opercular occlusors. Two short cylindrical spines on the distal border of the opesia, absent in ovicelled zooids; on either side of the orifice a pair of large hollow, intricately-branched and antler-like spines, curving inwards over the frontal membrane. These cervicorne spines are variously developed, and may be broken short in older material, their position marked by a pair of thickened, socket-like bases. Adventitious avicularia present, typically one pair per zooid, situated on the gymnocyst and directed medioproximally, mandible elliptical. Ovicell spherical, imperforate, finely granular, partially immersed in the succeeding zooid, closed by the operculum of the maternal zooid. On zooids succeeding non-ovicelled individuals a small, simple kenozooid, with an oval opesia, occurs between the paired avicularia.

Ancestrula elongate, up to 1 mm in length, posteriorly cylindrical, smooth and bifid. Frontal membrane occupying about three-quarters of the length of the zooid, underlain by a flaring, finely granular cryptocyst with a few small marginal spines. Opesia oblong.

Etymology

Cervus (L)—a deer, cornu (L)—a horn, referring to the spines.

Remarks

The ancestrula buds two zooids from its distobasal surface; from these a triplet of zooids is budded, thereafter new zooids are added in alternating whorls of three, giving a hexagonal section to the colony. Zooids of the first two astogenetic generations may be more slender than later ones, but otherwise differ from them in no significant way, although the small kenozooids are more frequent on the proximal parts of the colony. In the largest colonies the ancestrula is frequently damaged and the earliest generations of zooids have their opesiae occluded by convex laminae of granular calcite, usually each with a small central foramen. The small kenozooids are inferred to give rise to supporting rhizoids, although none were found in the material studied.

Notocoryne cylindracea (Busk, 1884)

Electra cylindracea Busk, 1884: 78, pl. 33 (fig. 2).

Material

Stations SM 16, SM 41.

Description

Colony erect, cylindrical, branching irregularly. Zooids oval, closely spaced, boundaries indistinct. Frontal surface largely occupied by an oval opesia; gymnocyst small and obscured, cryptocyst narrow, a distinct mural rim surrounding the distal half of the zooid. Occlusor laminae closely applied to the terminal wall. Four distal oral spines present; the distalmost pair short, thick and cylindrical, the proximal pair flattened, blade-like, curving over the frontal membrance. A single avicularium occurs on the gymnocyst, the rostrum elongate, lanceolate, directed distally, over the frontal membrane, occasionally laterally or proximally. A broad, cervicorne spine arises from the base of the avicularium and extends over the proximal half of the opesia. A second type of avicularium arises from the distal wall, single or paired, columnar, with a short, acute mandible; rarely this may replace the elongate, proximal type. Ovicell hemispherical, smooth, with a triangular frontal lacuna bounded by raised ridges. The ovicell is usually intimately associated with the distal avicularia.

Remarks

The principal justification for assigning *Electra cylindracea* to the new genus *Notocoryne* lies in the form of its colony, although zooid morphology is

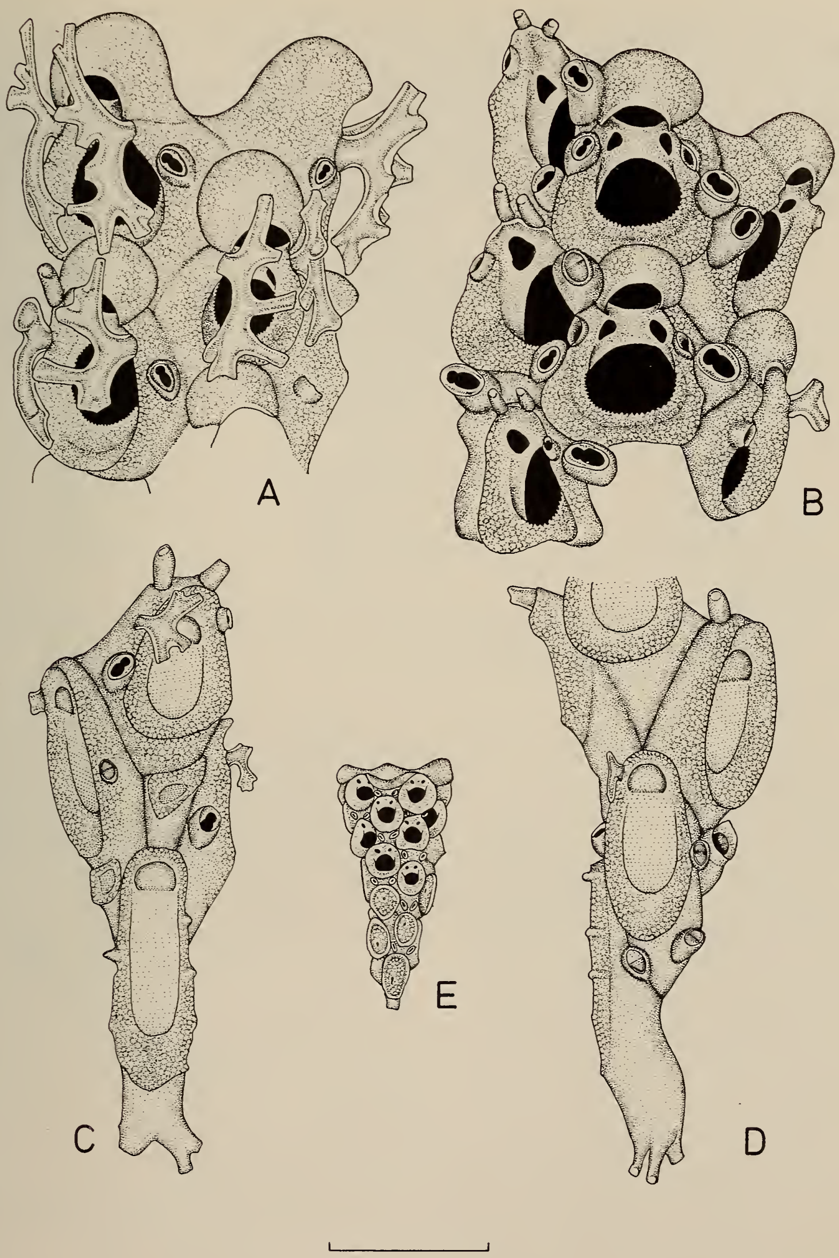

Fig. 3. *Notocoryne cervicornis* gen. et sp. nov. A. Zooids at the distal tip of a colony. B. The characteristic appearance of older zooids, with spines lost. C. The ancestrula of a young colony. D. The same in lateral view. E. A complete colony, the most proximal zooids with occluded opesiae. Scale = 0,5 mm for A–D; 4 mm for E.

strikingly similar to that of the type species. The colony of *N. cylindracea* is developed from a single, elongate ancestrula which, in larger specimens, becomes enclosed by basally directed rhizoids.

Two fragments only were obtained by the *Meiring Naude*. Described by Busk (1884) from Prince Edward Island, *N. cylindracea* has not been reported before from South African waters and these records possibly mark the northern limit of its geographical range.

Family **Scrupocellariidae** Levinsen, 1909

Scrupocellariidae Levinsen, 1909: 130. Ryland & Hayward, 1977: 128.

Notoplites Harmer, 1923

Notoplites Harmer, 1923: 348. Ryland & Hayward, 1977: 131.

Notoplites cassidula sp. nov.

Fig. 4A–C

Material

Holotype: SAM–A26299, station SM 23, 27°44,4′S 32°42,8′E, 400–450 m.
Other material: Stations SM 60, SM 86.

Description

Colony erect, forming diffuse tufts up to 1,5 cm high, branching dichotomously; bifurcations of Type 15 (Harmer 1923). Zooids elongate, slender, biserially arranged; opesiae oval, each occupying half the frontal surface of the zooid, not overlapping but strictly alternating along the length of the branch. Cryptocystal rim narrow, scutum absent; four or five delicate oral spines present, frequently broken short. An adventitious avicularium present on the outer distal angle of each zooid, mandible short, triangular, directed laterally. Frontal avicularia also present, with short, triangular mandibles orientated perpendicularly to the long axis of the branch; when borne by ovicelled zooids, the orientation of the frontal avicularia is reversed, they are closely associated with the ovicells and directed distally. Enlarged frontal avicularia sporadic; rostrum hooked, supporting a short, triangular mandible. Ovicell small, domed, resembling a small helmet (hence, *cassidula*), but not projecting prominently from the branch; with a transversely elongate frontal fenestra, not closed by zooidal operculum. Basal avicularia absent. Each zooid has a number of conspicuous septula on the basal surface, at the points of origin of long rhizoids. These traverse the length of the colony, closely applied to the basal surface, forming proximally a thick bundle of anchoring rootlets.

Etymology

Cassidula (L)—a little helmet, referring to the ovicell.

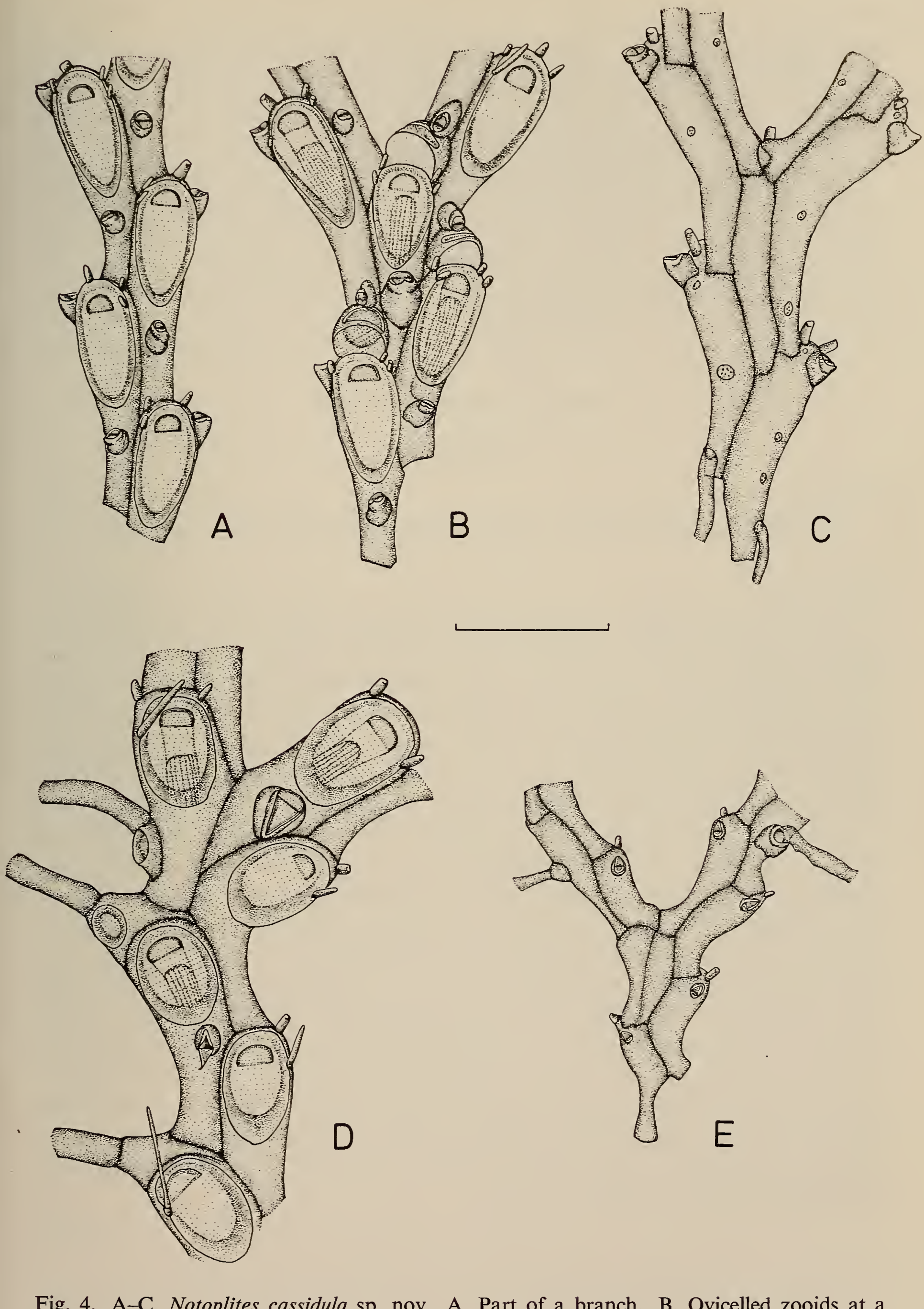

Fig. 4. A–C. *Notoplites cassidula* sp. nov. A. Part of a branch. B. Ovicelled zooids at a bifurcation. C. Basal view of a bifurcation, two rhizoids proximally. D–E. *Notoplites candoides* sp. nov. D. Part of a colony, including a bifurcation, showing parts of three lateral processes. E. A bifurcation in basal view. Scale = 0,5 mm for A–D; 1 mm for E.

Remarks

The genus *Notoplites* Harmer is defined precisely by its method of bifurcation, shown clearly in the present species (Fig. 4C). The scutum may be present or absent, but the lateral avicularia, fenestrate ovicell and oral spines of *N. cassidula* are typical of the genus. The antarctic and subantarctic species of *Notoplites* were monographed by Hastings (1943), and four Indo-West-Pacific species were described by Harmer (1926). *N. cassidula* differs from all the species included by these two authors, and bears no resemblance to any cellularine species described from this area by earlier writers. It is characterized by the lack of scutum and basal avicularium, the shape and size of the ovicell and the form of the two types of frontal avicularia.

Notoplites candoides sp. nov.

Fig. 4D–E

Material

Holotype: SAM–A26300, station SM 23, 27°44,4′S 32°42,8′E, 400–450 m.

Description

Colony erect, branching dichotomously, bifurcations of Type 15 (Harmer 1923); branches linked laterally by stout chitinous rhizoids, giving a loose, reticulate structure, reminiscent of a species of *Canda*. Zooids elongate, biserially arranged; opesiae oval, each occupying about one half the frontal surface of the zooid; angled to the long axis of the branch, thereby imparting a saw-toothed outline. Cryptocystal rim broad, scutum absent; two or three distal oral spines present, delicate and frequently broken short. A single adventitious avicularium present on the gymnocyst of each zooid, immediately proximal to the opesia, acute to frontal plane; mandible acute triangular, directed distally or proximally. Enlarged avicularia occur sporadically, replacing the frontal type and essentially of the same form. A second avicularium present on the basal surface of each zooid, situated on the outer distal corner and directed disto-laterally. The broad, tubular rhizoids linking the branches arise from enlarged kenozooids, with small circular opesiae; these are developed on the basal, frontal or lateral surfaces of the colony and their position varies from zooid to zooid. Occasionally a kenozooid is developed on the distal wall of the terminal zooid in a row, when the small opesia may be missing. The rhizoids typically extend laterally, probably fusing with, and certainly continuous with, those arising from neighbouring branches. Others trail proximally and perhaps serve to secure the colony to the substratum.

Etymology

Canda—a bryozoan genus, oides (G)—like, referring to the appearance of the colony.

Remarks

A single, damaged, colony of this species was found, comprising four branching fragments up to 1 cm long. Regrettably, both early stages and brooding zooids were absent but the morphology of this species is so unusual that it is certain that it has not been described before. The cross-linking rhizoids are a feature of the genus *Canda* Lamouroux, but the method of bifurcation and the type and distribution of avicularia place this species unequivocally in *Notoplites* Harmer.

Tricellaria Fleming, 1828

Tricellaria Fleming, 1828: 540. Ryland & Hayward, 1977: 143.

Tricellaria varia sp. nov.

Fig. 5

Material

Holotype: SAM–A26295, station SM 103, 28°31,7'S 32°34,0'E, 680 m.

Description

Colony erect, branching, jointed; bifurcations of Type 9 (Harmer 1923). Internodes of three to nine zooids, a variable but always uneven number, separated by well developed brown, chitinous joints. Zooids in biserial rows, slender; opesiae oval, occupying just less than half the frontal surface, alternating and not overlapping. Cryptocystal rim narrow, scutum broad, consisting largely of an extensive proximal lobe. Two spines present on the outer distal edge of each zooid. Presence, frequency and size of adventitious avicularia very variable; most frequent are lateral avicularia, situated on the outer distal corner of the zooid. These are of varying size, may be present on a few or all of the zooids of a colony, or may be absent altogether. Even rarer are minute frontal avicularia which may occur on the gymnocyst immediately proximal to the opesia. This variability may impart remarkably different appearances to different colonies, but intermediate branches may always be found. Rhizoids issue from large kenozooids sporadically present basally, at the proximal end of the zooid. Ovicell globular, smooth, with a small fenestra close to its opening.

Etymology

Varia (L)—different, referring to the variability of the avicularian characters.

Remarks

The material of this species was extensive but fragmentary, comprising portions of several different colonies, the largest fragment being about 7 mm long. The range of internode size and the variation in avicularia caused initial

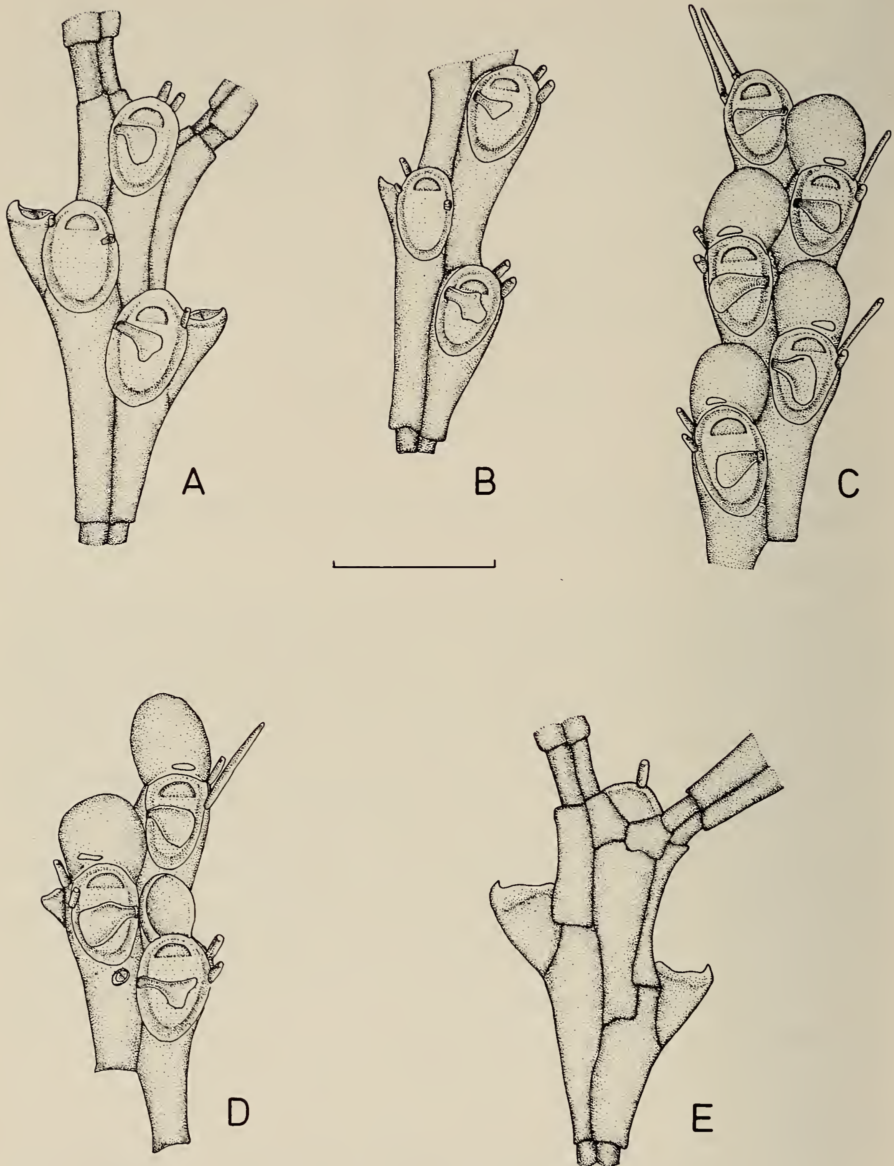

Fig. 5. *Tricellaria varia* sp. nov. A. An internode, with well-developed lateral avicularia. B. Three zooids, with a single small lateral avicularium. C. Ovicelled zooids. D. Three zooids, one with a minute frontal avicularium. E. Basal view of a bifurcation. Scale = 0,5 mm.

confusion in the determination of this species, but sufficient intermediate specimens were found to demonstrate that only one species was present.

T. varia is distinguished from other species of *Tricellaria* by the variable lateral avicularia, and the almost complete absence of frontal avicularia. It has fewer spines than most southern hemisphere species and, as in many of the Scrupocellariidae, the morphology of the ovicell appears to be characteristic.

Eupaxia Hasenbank, 1932

Eupaxia Hasenbank, 1932: 321, 363.

Eupaxia quadrata (Busk, 1884)

Fig. 6C–F

Cellularia quadrata Busk, 1884: 18, pl. 5 (fig. 5).
Eupaxia incarnata Hasenbank, 1932: 363, fig. 30A–C.

Material

Stations SM 16, SM 92, SM 103.

Description

Colony erect, slender, branching dichotomously, up to 5 cm high; deep carmine in alcohol preserved specimens. Zooids in two alternating, longitudinal series, the frontal planes at an obtuse angle; elongate, rectangular, approximately 1 mm long by 0,35 mm wide, lightly calcified with a completely membranous frontal surface. Distolaterally each zooid bears a small adventitious avicularium, mandible short, triangular, orientated at a right angle to the branch and directed laterally. Basally, the avicularium may be seen to be linked to the outer proximal corner of the zooid by a slender tube, most clearly visible at the growing tips of the colony. Elsewhere, additional tubes arise in the same region of each zooid, traverse the edges of the basal surface of the colony as rhizoids, gathering proximally into a bundle and anchoring the colony. At a bifurcation the basal rhizoids cross from the inner edges of the two branches to the outer edges of the supporting ramus (Fig. 6F). Ovicells were not found, and perhaps do not occur. Ancestrula of similar size to later zooids with, additionally, a slender proximal portion continued as an elongate tube. The ancestrula and earliest zooids are typically ensheathed by rhizoids. The coloration of the colony is very characteristic and seems to be derived from pigment in the polypide and from coarse granules in the coelomic fluid.

Distribution

E. quadrata was reported by Busk (1884) from Kerguelen and Heard Islands at depths of 51 m (28 fms) and 137 m (75 fms). Hasenbank's material was collected off the Somali coast, at the far greater depth of 1 668 m, where it possibly approaches the northern limit of its range.

Family **Bicellariellidae** Levinsen, 1909

Bicellariellidae Levinsen, 1909: 93. Ryland & Hayward, 1977: 146.

Bugulella Verrill, 1879

Bugulella Verrill, 1879: 472. Maturo & Schopf, 1968: 36.

Bugulella australis sp. nov.

Fig. 6A–B

Erymophora sp. Hastings, 1943: 469, fig. 56.

Material

Holotype: SAM–A26302, station SM 23, 27°44,4′S 32°42,8′E, 400–450 m.
Other material: stations SM 16, SM 23, SM 32, SM 86.

Description

Colony erect, branching; delicate, forming diffuse, tangled clumps, frequently attached to sponges or to other bryozoans (*Adeonella* spp.). Zooids in single, linear series, branching frequently; elongate, a slender tubiform proximal portion broadening abruptly to an oval distal portion bearing an oval opesia, with a narrow cryptocystal rim. Ten delicate marginal spines present, the two distal pairs short and erect, the rest incurved over the frontal membrane. Avicularia infrequent; pedunculate, attached to the disto-basal wall of the zooid, rostrum prominent, supporting a semi-elliptical mandible. Ovicell globular, thin walled, with an irregular, tessellate surface and a few indistinct pores. Each zooid develops a short peduncle on its distobasal wall from which the next zooid is budded, separated from the peduncle by a joint or constriction. A bifurcation is initiated when a slender, unjointed tube arises close to the origin of the new zooid and grows parallel to it. As the new zooid broadens distally a short tube develops from its proximal lateral wall, fusing with the tube adjacent to it. Above the point of fusion a joint is developed and from this a second zooid buds, diverging from the first at an angle of about 60°. Each zooid bears four lateral septula, two distal and two proximal; it is from the proximal septula that the short lateral tubes are derived; they do not arise from the distal septula, the significance of which is consequently unclear. Numerous specimens were obtained; all were alive when collected, and many bore embryos.

Etymology

Australis (L)—southern, referring to the geographical distribution.

Remarks

B. australis was formerly known by a single small specimen described by Hastings (1943) as '*Erymophora* sp. indet'. Her material was from an unknown locality.

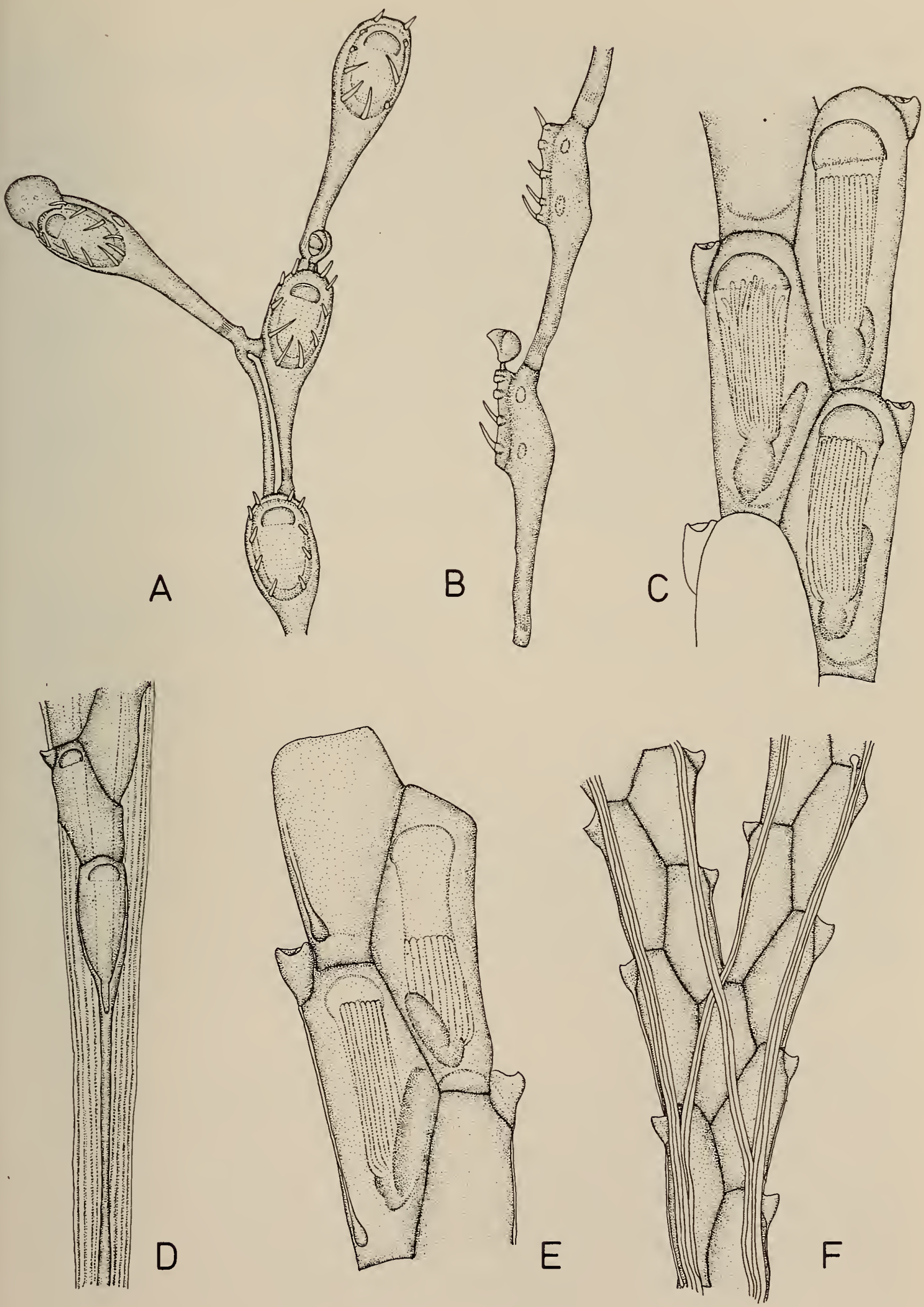

Fig. 6. A–B. *Bugulella australis* sp. nov. A. Part of a branch including a bifurcation. B. Two zooids in lateral view showing an avicularium. C–F. *Eupaxia quadrata* (Busk). C. Three zooids in frontal view. D. The ancestrula, enveloped by rhizoids. E. Zooids from the tip of a branch in basal view. F. Basal view of a dichotomy. Scale = 0,5 mm for A–C, E; 1 mm for D, F.

Leiosalpinx gen. nov.

Colony erect, branching dichotomously, unjointed. Zooids in single linear series. No avicularia, spines or ovicell.

Type species: *Alysidium inornata* Goldstein, 1882.

Alysidium inornata Goldstein (= *Catenaria attenuata* Busk) was placed by Hastings (1943) in the genus *Brettia.* As presently constituted *Brettia* embraces a considerable number of species, from most parts of the world, whose only common feature seems to be an erect, uniserial habit. Ryland & Hayward (1977) pointed out that the type species of *Brettia*, *B. pellucida* Dyster, was based on a single, dead fragment collected at Tenby, South Wales. The type specimen, although extant, is unrecognizable and no further material has ever been collected. The definition and systematic status of *Brettia* is thus open to doubt and there seems to be little excuse for continuing its use, particularly in describing faunas from regions remote from the British Isles. It is appropriate, therefore, to introduce a new genus for *Alysidium inornata* Goldstein in the hope that a critical re-examination of the species currently assigned to *Brettia* Dyster may be encouraged.

Etymology

Leios (G)—smooth, salpinx (G)—a trumpet, referring to the shape of the zooids.

Leiosalpinx inornata (Goldstein, 1882)

Fig. 2C–D

Alysidium inornata Goldstein, 1882: 42, pl. 1 (fig. 1).
Catenaria attenuata Busk, 1884: 14, pl. 2 (fig. 1).
Brettia inornata: Hastings, 1943: 476.

Material

Station SM 107.

Description

Colony erect, diffuse, branching dichotomously; zooids in single linear series, slender, very elongate, horn-shaped, calcification thin and translucent. The zooid is broadest distally, where it bears an oval opesia, comprising no more than one-sixth of the total zooid length. New zooids budded from the disto-terminal walls, linked to their predecessors by an uncalcified node. Dichotomies arise simply when the terminal zooid produces two buds, widely spaced and distolaterally orientated; there is no connection between the two new zooids (cf. *Bugulella*). As noted by Hastings (1943), the surfaces of the zooids are often covered by detritus, usually obscuring the borders of the opesia. The operculum was unclear in all specimens studied.

Remarks

Several small colonies were found, each tangled among specimens of *Bugulella australis*.

Distribution

At present *L. inornata* is known only from Marion and Heard Islands.

Family **Farciminariidae** Busk, 1852

Farciminariidae Busk, 1852: 32. Harmer, 1926: 401.

Columnella Levinsen, 1914

Columnella Levinsen, 1914: 571.
Levinsenella Harmer, 1926: 402.

Columnella magna (Busk, 1884)

Fig. 9A

Farciminaria magna Busk, 1884: 49, pl. 5 (fig. 1).
Columnella magna: D'Hondt, 1975*a*: 563.

Material

Station SM 67.

Description

Colony erect, branching dichotomously, delicate and very lightly calcified. Zooids in four longitudinal series, each comprising one facet of a quadrate branch section; rectangular, frontal surface entirely membranous, transparent, 1,4 mm long by 0,3 mm broad. Operculum thin, lightly chitinized, no spines, ovicells not present in material collected. Avicularia small, adventitious, infrequent; occurring, rarely, at the proximal end of the zooid, mandible semicircular, perpendicular to frontal plane.

Remarks

A single fragment was collected, 2 cm long and including two bifurcations.

Distribution

Columnella magna is a deep water species with a wide geographical distribution. Described by Busk from off Uruguay and from south of Heard Island, it has since been reported from the North Atlantic (Silén 1951, D'Hondt 1975*a*) and the Bay of Biscay (Hayward 1978*a*).

Nellia Busk, 1852

Nellia Busk, 1852: 18. Harmer, 1926: 240.

Nellia sp.

Fig. 2E–F

Material

Station SM 60.

Description

Colony erect; jointed? Branches quadrate in section, composed of four longitudinal series of zooids, spiralling around the branch axis. Zooids rectangular, frontal surface comprising a large oval opesia with a narrow, granular cryptocyst, raised into a crenellated mural rim. Gymnocyst reduced, bearing one or two adventitious avicularia, mandibles semicircular, directed proximolaterally. No spines. Ovicell spherical, granular and imperforate; immersed, and closed by zooidal operculum.

Remarks

Three very small fragments were found, none of which included a joint. Clearly attributable to *Nellia*, this species is distinct from other known species, but in view of the extreme paucity and fragility of the material available it is impossible to obtain a complete idea of its morphology. Consequently, it is necessary to await the collection of further specimens before a name can be applied.

Family **Alysidiidae** Levinsen, 1909

Alysidiidae Levinsen, 1909: 201. Harmer, 1957: 641.

Petalostegus Levinsen, 1909

Petalostegus Levinsen, 1909: 114. Harmer, 1957: 642.

Petalostegus bicornis (Busk, 1884)

Catenaria bicornis Busk, 1884: 14, pl. 2 (fig. 2).
Petalostegus bicornis: Harmer, 1957: 642, pl. 51 (figs 13–18), fig. 118.

Material

Stations SM 1, SM 107.

Description

Colony erect, branching, jointed, diffuse; each internode comprising a single zooid. Each zooid spatula shaped, a slender, smooth proximal portion expanding abruptly to form a club-like distal portion containing the polypide. Frontal shield of distal portion formed of several flattened and overarched plates. New zooids budded distally and laterally. A single avicularium present on each of the distolateral corners of the zooid.

Distribution

Described from the Society Islands, in the mid-Pacific, *P. bicornis* has also been reported from two localities in Indonesia; the present records are the first from the western side of the Indian Ocean.

Family **Cellariidae** Hincks, 1880

Cellariidae Hincks, 1880: 103. Ryland & Hayward, 1977: 119.

Cellaria Ellis and Solander, 1786

Cellaria Ellis & Solander, 1786: 18. Ryland & Hayward, 1977: 119.

The phylogenetic relationships of the southern hemisphere species of *Cellaria* present certain problems. The first of the two species described below, *C. tectiformis* sp. nov., has a distinctive node formation, unlike that of the type species, *C. sinuosa*, or, indeed, of the majority of the northern species. The second species, *C. paradoxa*, displays a pattern of early astogeny which is perhaps unique among described species. The joints of *C. tectiformis* are similar to those described in *C. tecta* by Harmer (1926), and in *Cellariaeforma aurorae* by Moyano (1969). However, *Cellariaeforma* Rogick is at present poorly defined and until a comparative study of the southern Cellariidae is accomplished, the two species described here are most usefully accommodated within *Cellaria* Hincks.

Cellaria tectiformis sp. nov.

Fig. 7

Material

Holotype: SAM–A26292, station SM 23, 27°44,4′S 32°42,8′E, 400–450 m.
Other material: stations SM 1, SM 16, SM 41, SM 86, SM 103.

Description

Colony erect, branching, jointed, forming a rigid, flat and open fan; up to 4,5 cm high in the material studied. Internodes square in section, about 0,6 mm wide, broadening in older specimens or where ovicells develop; basal internodes up to 14 mm long, distal internodes typically shorter. Dichotomies smooth, symmetrical, U-shaped: subsequently, fractures develop around the base of each new internode which is then secured to its origin by a tangled knot of rhizoids, arising from the epithecae of the zooids distal to the fracture. Basally, the colony is supported by a single internode, which in the largest colonies is entirely obscured by a mass of brown rhizoids. This forms a broad holdfast, securing the colony to the substratum. Zooids in four alternating longitudinal series, each comprising one face of the branch; hexagonal, truncate distally and proximally, laterally extending on to two other faces of the branch. Boundaries marked by distinct raised sutures. Cryptocyst depressed medially, delimited laterally and distally by a low ridge; opesia occupying about one-

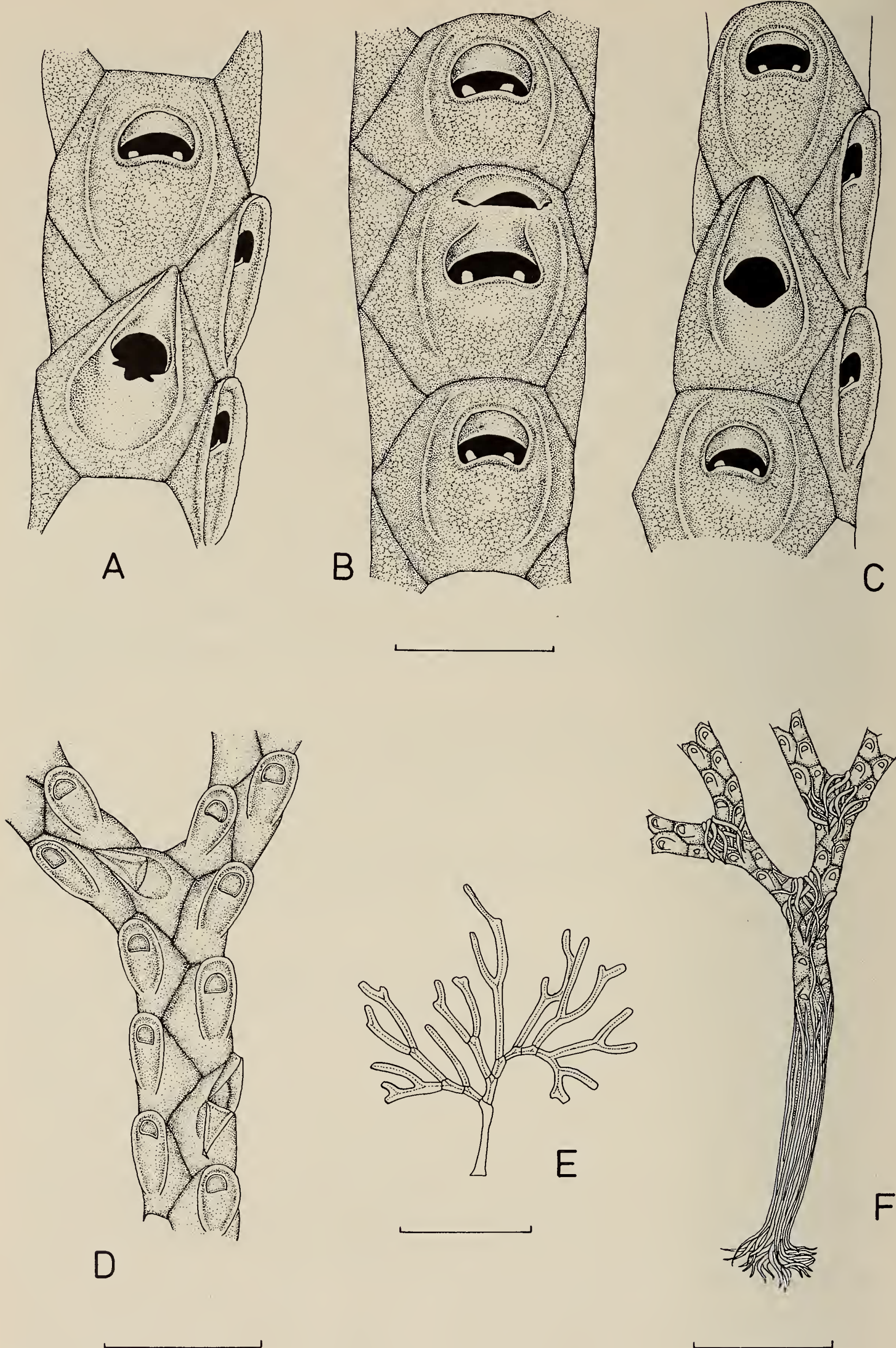

Fig. 7. *Cellaria tectiformis* sp. nov. A. Part of an internode, including an avicularium. B. Part of a branch, including an ovicelled zooid. C. An avicularium with an unusual orientation. D. A new bifurcation, showing the avicularium at the base of one ramus. E. Outline diagram of colony form. F. Old bifurcations, and the base of the colony, showing rhizoids. Scales = 0,5 mm for A–C; 1 mm for D; 10 mm for E; 2,5 mm for F.

quarter of the total frontal surface, broadly crescentic, twice as wide as long, the proximal border forming a rounded or quadrate lip, beyond which two blunt, proximal denticles are visible. Ovicells endotoichal, position indicated by a broadening of the ramus in fertile areas; opening of ovicell a narrow, transverse slit, arched over by a short, domed canopy arising immediately distal to it. Avicularium vicarious, as large as an autozooid; opesia oval, comprising less than one-third of total length of heterozooid, rostrum acute, raised, supporting a hooked, triangular mandible. Avicularia are found infrequently along the length of the branch, but one occurs constantly at the base of each internode, immediately above the dichotomy. The rostrum is usually orientated transverse to the branch axis, but occasionally it may be directed distally.

No complete ancestrulae were found, but in two specimens sufficient detail was visible to indicate the pattern of early astogeny. The first eight zooids budded are biserially arranged; buds 9 and 10 assume diametrically opposite orientations to those preceding them and with buds 11 and 12 the four-faceted branch is established.

Etymology

Tecta—a species of *Cellaria*, forma (L)—shape, referring to the similarity with *C. tecta.*

Remarks

The flat, fan-like colony of this species is characteristic of several southern Cellariidae, and is in complete contrast to the dense, bushy form assumed by, particularly, the European species of *Cellaria.* In colony form, structure of the joints and the form of the ovicellar orifice this species most resembles the Indo-West-Pacific *Cellaria tecta* Harmer (hence, *tectiformis*), but differs from it in the size and proportions of the zooids and avicularia, and in the structure of the zooidal opesia.

Measurements (means of 10 values) in mm

Lz	lz	Lop	lop	Lav	lav
0,63	0,62	0,13	0,2	0,68	0,35

Cellaria paradoxa sp. nov.

Fig. 8

Material

Holotype: SAM–A26291, station SM 1, 27°00,8′S 33°03,1′E, 688 m.
Other material: stations SM 86, SM 103.

Description

Colony erect, attached by chitinous rootlets derived from frontal eipithecae of the lowest zooids; possibly branching, although only single rami were found, without indication of nodes. Up to 1,8 cm high, with a maximum width of about 1 mm. Proximally the colony is very slender, 0,2–0,4 mm broad, commencing as a slender, fusiform ancestrula, the epitheca of which, proximally, forms a fine rootlet. First generations of buds similar in size to ancestrula, biserially arranged, frontal surfaces at approximately 45° to each other. After about eight astogenetic generations a third series of zooids develops; the branch now assumes a rectangular section, three facets being occupied by zooid frontal surfaces, the fourth comprising the lateral walls of the two outer series. After a further eight or ten astogenetic generations three more series of zooids are developed and the branch section is elongated, giving a slim, rectangular shape. The two narrowest faces are occupied each by a single series of zooids, with obliquely orientated opesiae. The third face of the branch is occupied by three alternating, longitudinal series of essentially similar zooids ('A' zooids), and the branch here attains its greatest width. The former basal surface is now occupied by a single series of very broad zooids ('B' zooids). This disposition is maintained through the whole of later growth stages.

Zooids at proximal end of colony elongate, pyriform, later approximately hexagonal. In the biserial areas of the colony a raised rim surrounds the depressed cryptocyst of each zooid. In later 'A' zooids this is absent, the frontal surface being generally concave between the raised lateral sutures, but they are retained in the single marginal series. In 'B' zooids there is a distinct cryptocystal rim, often completely encircling the opesiae. In all zooids the opesia is semicircular, with a quadrate proximal lip and paired, blunt denticles. Additional paired denticles present distally, but less distinct. Opesiae larger in 'B' zooids than in 'A' zooids. Avicularia not observed, although small, triangular kenozooids were present, each with a circular central opesia. These occurred constantly distolateral to the outer series of 'A' zooids, infrequently among the marginal zooids, and never in association with 'B' zooids; they occurred also among the biserial and triserial regions of the colony and appear to be the origin of the anchoring rhozoids.

Etymology

Paradoxus (G)—strange, referring to the zooidal dimorphism.

Remarks

Dimorphic zooids do not appear to have been described before for any species of *Cellaria*. The differences between the 'A' and 'B' zooids of *C. paradoxa* are so striking that the two aspects of the branch, viewed side by side, suggest two distinct species. There seems little doubt that the dimorphism is sexual in nature as ovicellar orifices occurred only among the series of 'B' zooids. However, not all of these large zooids seem to develop ovicells and other functional differences may be involved. The astogenetic changes apparent in a large colony are also extraordinary, the proximal, biserial regions closely resembling a species of *Euginoma*. Such is the degree of difference between

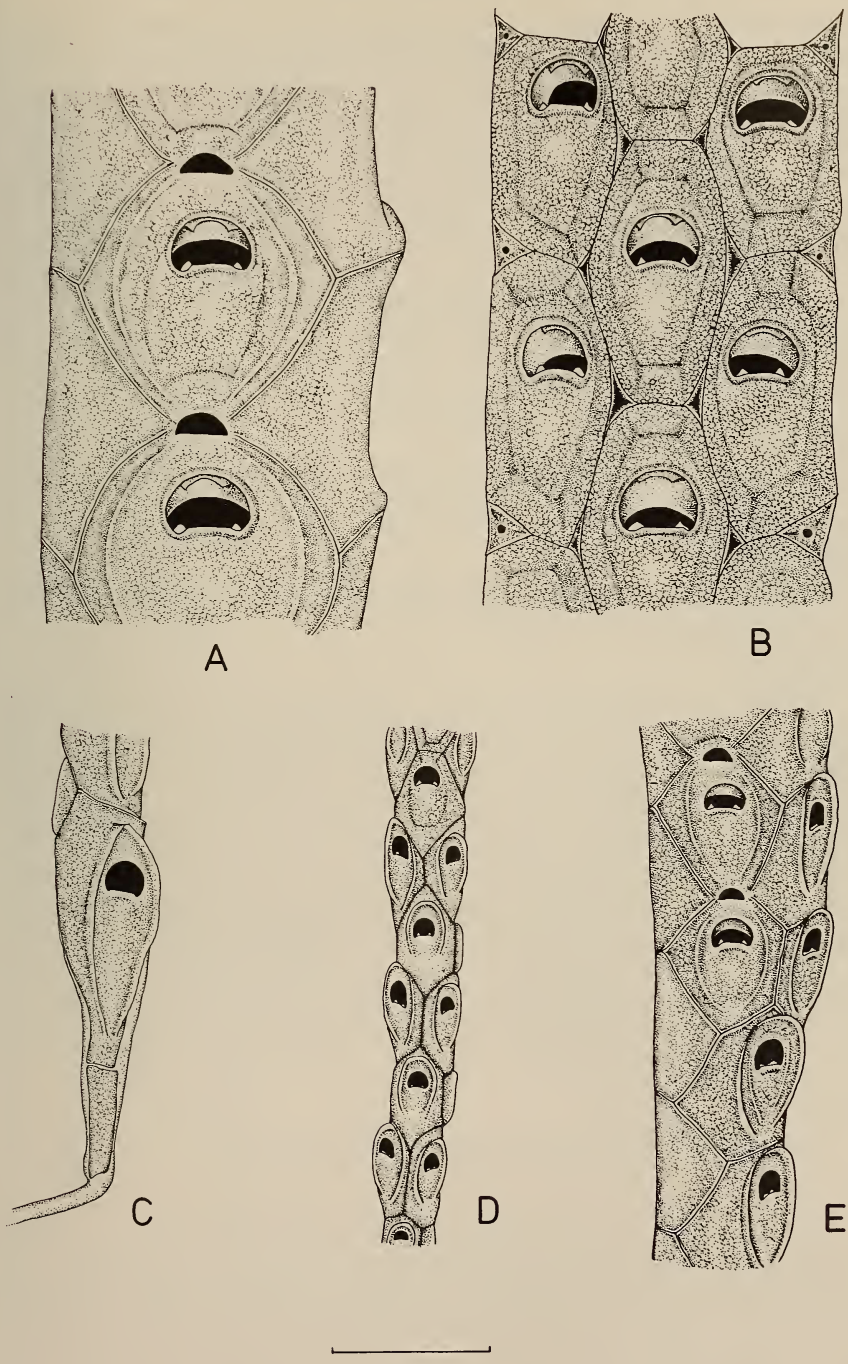

Fig. 8. *Cellaria paradoxa* sp. nov. A. Two ovicelled 'B' zooids. B. The reverse of the branch, 'A' zooids. C. The ancestrula. D. The proximal part of a colony, showing the biserial arrangement developing into a triserial form. E. Part of a branch showing the inception of 'B' zooids. Scale = 0,5 mm for A–C; 1 mm for D–E.

astogenetically old and young fragments that it would not be possible to consider them to constitute a single species, if a complete colony, displaying transitional stages, had not been obtained.

Measurements (means of 10 values) in mm

	Lz	lz	Lop	lop
'A' zooids	0,80	0,47	0,14	0,20
'B' zooids	0,82	0,74	0,15	0,24

Family **Aspidostomatidae** Jullien, 1888

Aspidostomatidae Jullien, 1888: 77. Harmer, 1926: 322.

Aspidostoma Hincks, 1881

Aspidostoma Hincks, 1881: 159. Harmer, 1926: 323.

Aspidostoma magna sp. nov.

Fig. 9C–D

Material

Holotype: SAM–A26310, station SM 23, 27°44,4′S 32°42,8′E, 400–450 m.
Other material: station SM 41.

Description

Colony erect, cylindrical, branching; stout, up to 1,5 mm wide, the largest fragment being 6 mm long. Zooids in three alternating, longitudinal series, their frontal surfaces occupying two-thirds of the circumference of the branch; hexagonal to polygonal, 1,2 to 1,4 mm long by about 0,8 mm broad, boundaries marked by raised sutures. Calcification thick, finely granular; frontal surface convex proximally, dipping distally to a deep, oval opesia occupying about one-third of the zooid length, bounded distally by a thickened, raised rim. Distolaterally, on each side, the rim is produced into a prominent, projecting lobe, often broken short. Proximal border of opesia forming a flared, bilobed lip, perpendicular to the frontal plane; a prominent conical knob proximal to it, often extended as a longitudinal rib. Ovicells large, subimmersed, with one or more frontal umbones.

Etymology

Magnus (L)—large, referring to the size of the zooids.

Remarks

The material of this species was fragmentary, but sufficient of its morphology was preserved to demonstrate its uniqueness. Few species of *Aspidostoma* are known, and only one living species, *A. cylindricum* Harmer (1926: 323), has an erect habit. *A. magna* is distinguished by its large size, the zooids being almost twice as large as any other species, and by the disposition of the zooid series which, in *A. cylindricum*, open on all surfaces of the branch.

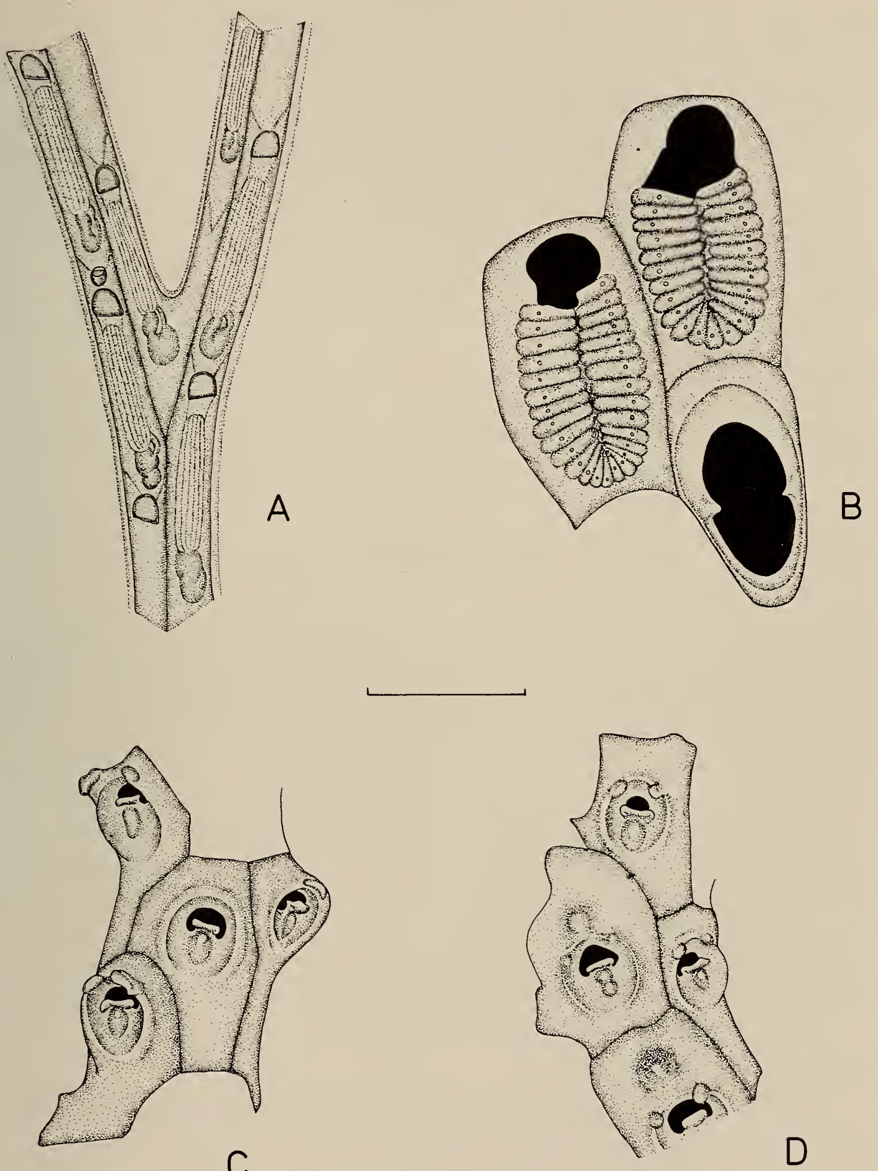

Fig. 9. A. *Columnella magna* (Busk). Part of the colony, including a bifurcation. B. *Figularia philomela* (Busk). Two damaged zooids and an avicularium. C–D. *Aspidostoma magna* sp. nov. C. A group of zooids. D. A fragment showing two ovicelled zooids. Scale = 0,5 mm for B; 1 mm for A, C–D.

Family **Cribrilinidae** Hincks, 1880

Cribrilinidae Hincks, 1880: 182. Hayward & Ryland, 1979: 56.

Figularia Jullien, 1886

Figularia Jullien, 1886: 608. Hayward & Ryland, 1979: 70.

Figularia philomela (Busk, 1884)

Fig. 9B

Cribrilina philomela Busk, 1884: 132, pl. 17 (fig. 6).

Material

Stations SM 16, SM 41.

Remarks

Two minute fragments only were found. One was unilaminar, but detached, and the other was bilaminar and evidently part of an erect, foliaceous colony. The zooids of both fragments were extensively damaged and all chitinous parts were missing. However, the avicularian rostrum is an important character in distinguishing the different species of *Figularia*, and the avicularium present in this material corresponds to that illustrated by Busk for *F. philomela*. This latter species, characterized by an erect, foliaceous habit, was collected by the *Challenger* from Marion Island. Busk distinguished encrusting material of his species, from the same locality, as *var*: *adnata*; but, as 'hemescharan' colonies are usually secured to the substratum by encrusting, unilaminar sheets of zooids, there seems to be little use in such a distinction.

Inversiscaphos gen. nov.

Colony minute, encrusting very small substrata. Zooids budded in alternating distolateral radial series. Gymnocyst extensive, costae simple, fused terminally forming a median keel (hence *Inversiscaphos*). Zooids communicating by large septulae (or pore-chambers with frontal windows?). Avicularia adventitious and terminal, interzooidal in position, paired. Mandibles long and setiform. Ovicells terminal, closed by the operculum, brooding zooids wide.

Type species: *Inversiscaphos setifer* sp. nov.

Etymology

Skaphe (G), scapha (L)—a boat, inversus (L)—upside down, referring to the shape of the zooids.

Inversiscaphos setifer sp. nov.

Figs 1B, 19

Material

Holotype: SAM–A26307, station SM 16, 27°33′S 32°44,6′E, 376–384 m.
Other material: station SM 16.

Description

Colony minute, encrusting sand grains. Ancestrula similar to subsequent zooids, primary zooids budded proximally or proximolaterally, subsequent zooids budded in alternating lateral series. Zooids small, with a distinct peripheral gymnocyst. Two pairs of large lateral septulae (which may be part of a lateral pore-chamber complex) with uncalcified windows present and facing frontally early in ontogeny. Windows obscured distolaterally by next zooid series. Frontal shield formed by seven to eight flat, wide, simple costae, fused terminally forming a distinct keel, lacunae absent. Intercostal areas simple slits, slightly enlarged peripherally to form rounded foramina, but with no intercostal fusions. Secondary calcified orifice elongated, narrowing proximally. Avicularia adventitious, budded in pairs from the terminal wall of each zooid, not communicating with other zooids. Basal wall of subrostral chamber reaching the substratum. Avicularia present on ancestrula, mandibles setiform, slung on asymmetrical condyles. Brooding zooids very wide, ovicell terminal, hyperstomial, imperforate, closed by the operculum.

Etymology

Setifer (L)—bristly, referring to the avicularian setae.

Remarks

The colony structure and zooid form of *I. setifer* do not appear to have been described before. It is inferred that the species is adapted to life in deep water and on minute substrata, and that the setiform mandibles have a stabilizing function similar to those of *Setosellina*. Cribrimorph bryozoans with very long, setiform avicularia are rare (see Waters 1888: 22). *Jolietina latimarginata* (Busk), which encrusts corals, and dead, erect bryozoans from very deep water, also has setiform avicularia, but a different growth pattern from *I. setifer*, which includes large, interzooidal kenozooids. The frontal shield has numerous intercostal fusions (see Busk 1884: 131, pl. 22 (fig. 10); Waters 1888: 22, pl. 1 (figs 11–12)).

The ancestrula and primary zooids of *I. setifer* all have the same morphology, and the primary buds are produced proximally from the ancestrula. The avicularian chambers are terminal, and do not appear to develop distal or lateral septulae. All subsequent zooids are budded alternately from the lateral-distal septulae of preceding zooid pairs. Avicularia are thus adventitious in origin, but interzooidal in position. The occurrence of avicularia as part of the ancestrula complex is unusual although it is known in the Cupuladriidae (Lagaaij 1963*a*). Avicularia with acute but not setiform mandibles are also known to be developed on the ancestrulae of some encrusting colonies, such as *Metrarabdotos* (Cook 1973*b*). The presence of the setiform mandibles in the ancestrular complex of both the Setosellinidae and Cupuladriidae, and in *I. setifer*, is inferred to indicate the importance of the establishment of a clearing and stabilizing function early in astogeny, in colonies living in sandy or muddy environments.

Ovicells are prominent, and appear to be a product of the distal wall of the maternal, brooding zooid. No distal zooids are budded from the ovicelled zooid, which are present in colonies with from nine to eleven zooids.

Measurements in mm

Lz 0,30–0,39	lz 0,20–0,24
Lbrz 0,39–0,41	lbrz 0,30–0,32
Ls 0,48–0,75	

Family **Exochellidae** Bassler, 1935

Exochellidae Bassler, 1935: 33. Hayward & Ryland, 1979: 78.

Escharoides Milne-Edwards, 1836

Escharoides Milne-Edwards, 1836: 218, 259. Hayward & Ryland, 1979: 78.

Escharoides distincta sp. nov.

Fig. 11D

Material

Holotype: SAM–A26308, station SM 23, 27°44,4′S 32°42,8′E, 400–450 m.
Other material: station SM 16.

Description

Colony encrusting. Zooids oval, convex, up to 1,2 mm long. Frontal wall thick and smooth, imperforate centrally, with a double row of marginal pores. Aperture broader than long, proximal border with a projecting, quadrate lip; a single avicularium on each side of the aperture, mandible oval, acute to plane of aperture and directed distolaterally. Two spines present on the distal border of the aperture, and one on each side; each lateral spine arises close to the avicularium and projects proximally to it. Ovicell globular, smooth, with a distinct frontal ridge.

Etymology

Distinctus (L)—different, referring to the distinctive character correlations of the species.

Remarks

Two small, damaged specimens only of this species were found, each comprising no more than six zooids. However, *Escharoides* is a very distinct and

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Fig. 10. A–D. *Adeonella coralliformis* O'Donoghue. A. Zooids from a growing tip. B. Later zooids. C. Diagram of the primary orifice. D. A branch viewed from the edge. E–H. *Adeonella majuscula* sp. nov. E. Two young zooids. F. Diagram of the primary orifice. G. Two older zooids. H. A branch viewed from the edge. I–L. *Adeonella cracens* sp. nov. I. Three young zooids. J. Diagram of the primary orifice. K. Three older zooids. L. A branch viewed from the edge. Scale = 0,5 mm for A–C, E–G, I–K; 1 mm for D, H, L.

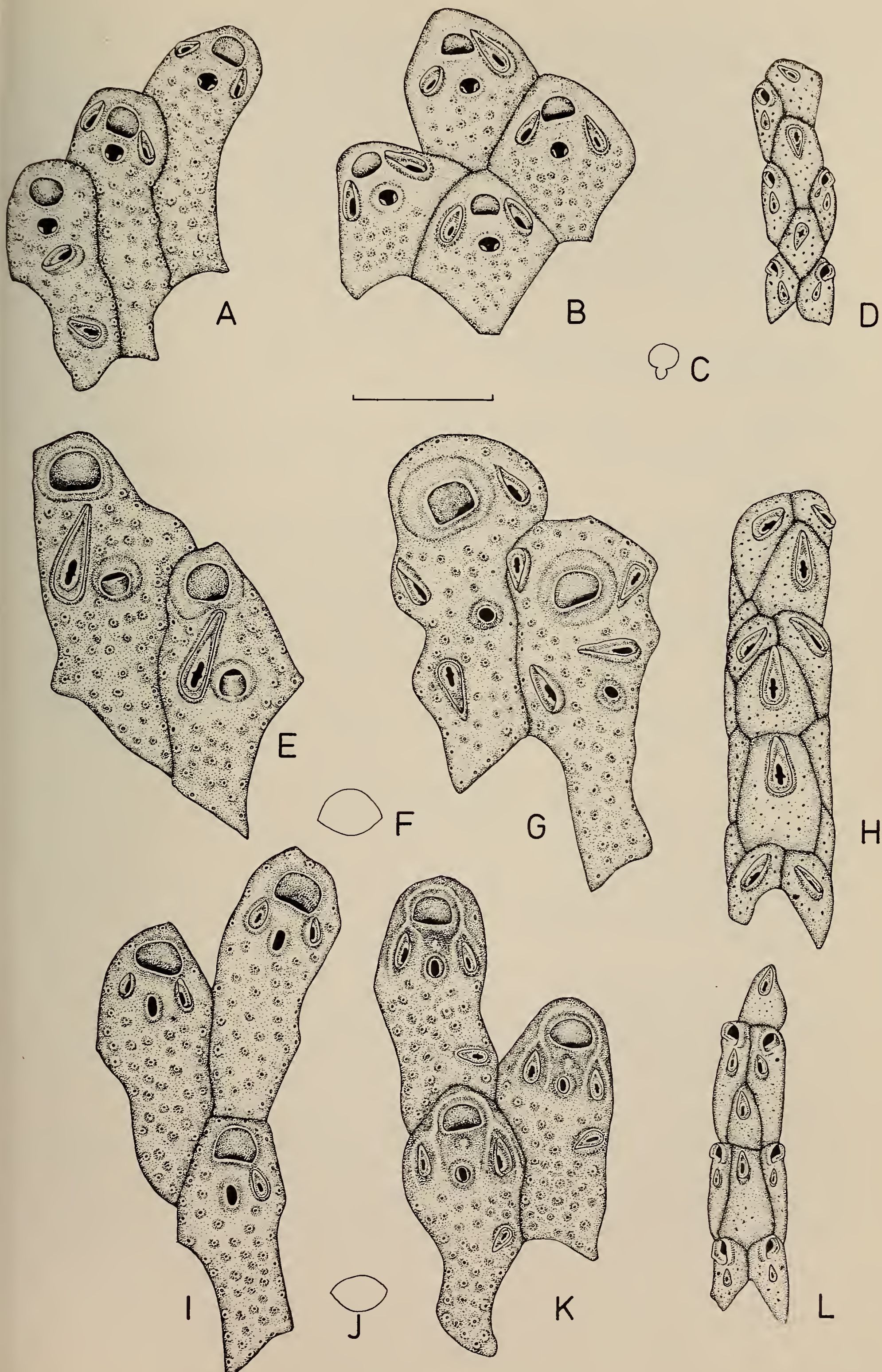

Fig. 10

well-defined genus; few species are at present described and each of these is characterized by the morphology of the apertural rim, the size and slope of lateral avicularia and the number and disposition of the oral spines. On these characters *E. distincta* may be distinguished from all presently known species.

Family **Microporellidae** Hincks, 1880

Microporellidae Hincks, 1880: 204. Hayward & Ryland, 1979: 220.

Flustramorpha Gray, 1872

Flustramorpha Gray, 1872: 168 Busk, 1884: 135.

Flustramorpha marginata (Krauss)

Flustra marginata Krauss, 1837: 35, fig. 3.
Flustramorpha marginata: Busk, 1884: 135, pl. 20 (fig. 8).

Material

Stations SM 23, SM 41.

Description

Colony erect, bilaminar, foliaceous. Zooids broad and flat, hexagonal, separated by raised sutures. Primary orifice semicircular. Frontal wall granular, with numerous small pores and a median crescentic ascopore. Avicularium adventitious, proximolateral to the orifice, rostrum oval, supporting a whip-like setiform mandible.

Remarks

Two small, damaged and very worn fragments were found, possibly an indication that they have been transported, perhaps, from shallower water.

Flustramorpha angusta sp. nov.

Fig. 11E

Material

Holotype: SAM–A26309, station SM 16, 27°33′S 32°44,6′E, 376–384 m.

Description

Colony erect, bilaminar, formed of narrow, strap-like branches. Zooids hexagonal, flat, separated by raised ridges; 0,7 mm long, by 0,4 mm wide. Primary orifice with straight proximal edge and curved distal edge, constituting less than a semicircle. Frontal wall minutely granular, with small scattered pores. Ascopore situated in the distal third of the zooid, immediately proximal to the orifice, crescentic, with a finely denticulate edge. Avicularium lateral, single, the cystid partially immersed in the zooid; rostrum broadly oval, with a median pivotal bar, mandible not seen. Ovicell globular, recumbent on the distally-succeeding zooid, prominent, surface granular and imperforate. The edges of the branch are channelled to receive supporting rhizoids.

Etymology

Angustus (L)—narrow, referring to the branches of the colony.

Remarks

A single specimen was found, 4 mm long and 1,5 mm broad, and consequently little can be said about the colony. However, this species is clearly referrable to *Flustramorpha* and differs from the two species presently known, *F. marginata* and *F. flabellaris*, in the slender, straplike colony form, the smaller size of the zooids, shape of the primary orifice, and in the structure of the ovicell, which is broader and bears marginal flutings in the latter two species.

Measurements (means of 10 values) in mm

Lz	lz
0,73	0,47

Family **Gigantoporidae** Bassler, 1935

Gigantoporidae Bassler, 1935: 32. Harmer, 1957: 878.

Gigantopora Ridley, 1881

Gigantopora Ridley, 1881: 47. Harmer, 1957: 879.

Gigantopora polymorpha (Busk, 1884)

Gephyrophora polymorpha Busk, 1884: 167, pl. 34 (fig. 2).
Adeonella ponticula O'Donoghue, 1924: 54, pl. 4 (fig. 23).
Gigantopora polymorpha: Brown, 1952: 208, figs 145–146.

Material

Station SM 103.

Description

Colony encrusting, or developing erect, bilaminar, cylindrical, foliaceous or reteporiform growths. Zooids broad, flat and polygonal, separated by raised sutures; frontal wall granular, with scattered, minute pores. Primary orifice orbicular, proximal edge concave. An elongate, triangular avicularium develops on each side of the orifice, directed medially, arching above the primary orifice and fusing to form a slender bridge.

Distribution

The species is known only from South Africa, although Tertiary fossil specimens have been reported from New Zealand by Brown (1952).

Family **Adeonellidae** Gregory, 1893

Adeonellidae Gregory, 1893: 241. Cook, 1973*a*: 246.

Adeonella Busk, 1884

Adeonella Busk, 1884: 183. Cook, 1968: 180.

Adeonella coralliformis O'Donoghue, 1924

Fig. 10A–D

Adeonella coralliformis O'Donoghue, 1924: 55, pl. 4 (fig. 24).
Adeonella coralliformis: Cook, 1973*a*: 254.

Material

Stations SM 16, SM 41, SM 86.

Description

Colony erect, branching, rigid. Branches flat, bilaminar, up to 4 mm broad; fragments only recovered, no complete colonies. Zooids in regular, quincuncial series, hexagonal or rhombic, becoming irregular in older parts of colony; convex, separated by shallow grooves rapidly infilled by secondary calcification. Primary orifice orbicular, with a deep, narrow sinus. Peristome low, thickened but not particularly prominent; spiramen situated immediately proximal to the secondary orifice, separated from it by a narrow bridge of calcite, thickening with age but often broken in dead material. Avicularia typically paired, lateral to secondary orifice, arising beside, or immediately distal to, the spiramen; rostrum acute triangular, directed distomedially and just extending on to the distal border of the peristome. Frontal wall finely granular, pierced by numerous small pores. Additional avicularia occur elsewhere on the frontal wall, but are not common. Vicarious avicularia, similar to and little larger than the adventitious types, may be distributed along the edge of the branch, but are not common; the edge is largely composed of normal autozooids overlapping from branch faces. Sexual polymorphs were not found, although they are described by Cook (1973*a*).

Distribution

This species is known only from South Africa. Both O'Donoghue (1924) and Cook (1973*a*) have commented on its resemblance to *A. regularis* Busk (1884), described from south-east of Cape Town, but Busk's description and figure are not easy to understand and it is not certain that the two species are the same.

Adeonella majuscula sp. nov.

Fig. 10E–H

Material

Holotype: SAM–A26311, station SM 86, 27°59,5′S 32°40,8′E, 550 m.
Other material: station SM 41.

Description

Colony erect, branching, rigid, attached by an encrusting base; at least 10 cm high and probably with an equivalent spread. Branches flat, narrow, bladelike, bilaminar. Zooids in numerous, alternating longitudinal series,

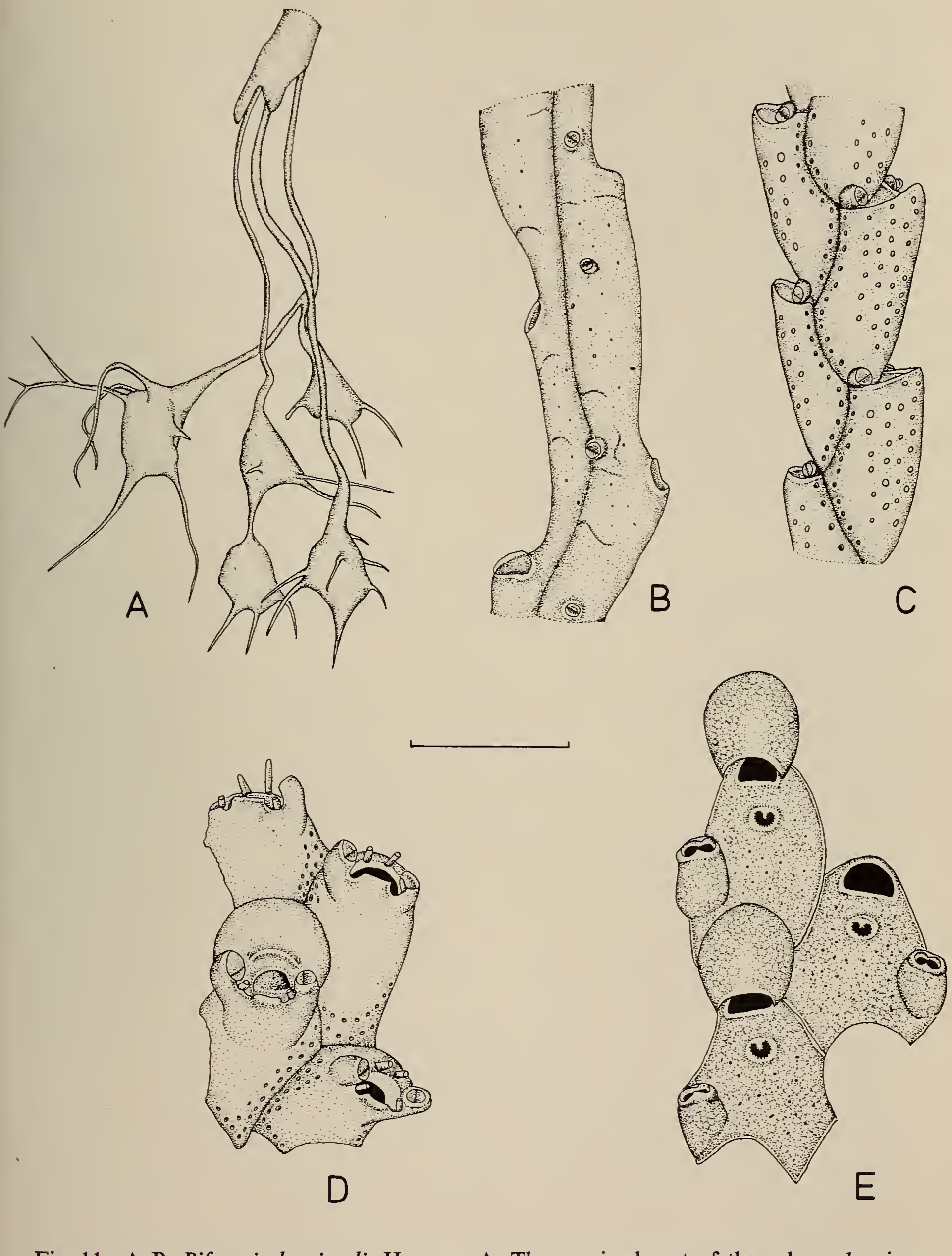

Fig. 11. A–B. *Bifaxaria longicaulis* Harmer. A. The proximal part of the colony showing rhizoids with their tuber-like swellings. B. The worn, main part of the specimen. C. *Bifaxaria submucronata* Busk. Part of the specimen. D. *Escharoides distincta* sp. nov. A group of zooids, including one with an ovicell. E. *Flustramorpha angusta* sp. nov. A group of zooids. Scale = 0,5 mm for B, E; 1 mm for A, C–D.

bifurcating frequently and diverging towards the edges of the branch, the outer series thus orientated transverse to the branch axis; oval to hexagonal, convex, separated by deep grooves. Primary orifice approximately semicircular, with a broad, shallow sinus proximally. Peristome prominent, thickened, fronto-terminal, secondary orifice orbicular; spiramen medially situated, occasionally displaced laterally, half-way between proximal border of secondary orifice and proximal edge of zooid. Frontal calcification thick and smooth, thickly punctured by numerous pores, in zooids at growing edge marginal pores are large and distinct, but are later little larger than frontal pores. Adventitious frontal avicularia single or paired, developing from marginal pores lateral, or just distal, to the spiramen; typically inclined distomedially, the elongate triangular mandible passing between spiramen and peristome. Frequently the avicularium is distally, or even proximally, directed; in older zooids they are obliterated and there is a proliferation of smaller frontal avicularia, with random orientation. Large vicarious avicularia present in continuous series along edges of the branch, and occasionally replacing marginal autozooids, rostrum identical to frontal adventitious type.

Etymology

Majusculus (L)—somewhat greater, referring to the size of the zooids.

Remarks

In the oldest parts of the colony peristomial orifices and spiramina became deeply immersed, narrowed and eventually obliterated; the surface of the branch develops a uniform, coarsely porous surface with numerous small adventitious avicularia. Secondary calcification appears to proceed most rapidly in the central parts of the branch, which thus develops a distinct keel. Dimorphic zooids were not found in any of the material studied, but are a feature of the genus *Adeonella*. The most useful taxonomic characters among the species of *Adeonella* appear to be the shape of the primary orifice, and the position of the spiramen and the avicularia relative to the peristome, although zooid size and colony form are also important. *A. majuscula* differs in these respects from all presently known species; it is the largest *Adeonella* occurring in these collections, and the wide gap between the secondary orifice and the spiramen is perhaps its most distinctive feature.

Measurements (means of 20 values) in mm

Lz	lz
0,97	0,51

Distribution

The genus *Adeonella* is widespread in tropical and subtropical waters. From a centre of distribution in the Indo-West-Pacific it ranges through the Indian Ocean, to the east and west coasts of Africa, and into the Western

Atlantic. A single species was described by Busk (1884) from South Africa (*A. regularis*, above), and several others by O'Donoghue (1924) and O'Donoghue & De Watteville (1944).

Adeonella cracens sp. nov.

Fig. 10I–L

Material

Holotype: SAM–A26312, station SM 86, 27°59,5'S 32°40,8'E, 550 m.
Other material: stations SM 23, SM 41.

Description

Colony erect, branching, rigid, attached by an encrusting base; at least 5 cm high, with an equivalent spread. Branches flat, strap-like, bilaminar, up to 6 mm broad; becoming cylindrical in older parts of the colony, where they are often narrower than later growth. Zooids in alternating linear series, bifurcating frequently and diverging towards the margin of the branch; elongate, rectangular or pyriform, becoming irregular, strongly convex and separated by deep grooves when newly developed. Primary orifice wider than long, proximal border deeply concave. Peristome low and thickened, little raised above the frontal plane of the zooid, secondary orifice approximately semicircular. Spiramen situated immediately proximal to the secondary orifice, in the distal third of the zooid; oblong, distoproximally orientated, becoming deeply immersed, the secondary opening developing a more circular outline. Avicularia single or paired, situated laterally between the spiramen and the peristome, distally directed; mandible acute triangular. Vicarious avicularia present in a continuous series along the edge of the branch, rostra identical to, and little larger than, those of the adventitious type. Frontal wall finely granular, closely punctured with numerous small pores. Dimorphic zooids were not seen.

Etymology

Cracens (L)—slender, referring to the shape of the branches.

Remarks

With continuing secondary calcification the peristome and spiramen become deeply immersed, as do the frontal avicularia. In this state the zooids have a very characteristic appearance, reminiscent of a species of *Micropora*. Additional frontal avicularia are developed on older zooids, apparently randomly distributed and with no discernible orientation. *Adeonella cracens* differs from the other species of *Adeonella* in the fauna most markedly in the shape of the primary orifice and the position of the spiramen and avicularia, relative to the secondary orifice. The shape of the spiramen, though obscured in the oldest parts of the colony, is also an important character. The zooids are smaller than those of *A. majuscula*, and the colony as a whole tends to be less extensive, with narrower, rather delicate branches, not developing the characteristic midrib of the latter species.

Measurements (means of 20 values) in mm

Lz	lz
0,97	0,34

Adeonella sp.

Fig. 12E

Material

Stations SM 16, SM 41, SM 103.

Distribution

Fragments of a small species of *Adeonella* occurred at three stations. It could not be assigned with confidence to any described species, and appeared to be distinct from each of the three species discovered in the present survey. However, the paucity of material, and the indifferent state of preservation of the few specimens available, prevent an adequate description, and further elucidation of the systematic status of this species must await the collection of more representative samples.

The specimens obtained represented fragments (up to 4,5 mm long and 1,5 mm wide) of branches, cylindrical in section and comprising just four series of zooids, the orifices opening all around the branch axis. In a few instances the branch was broadened to six or eight series. The zooids are rectangular and elongate, smaller than any of the other species recorded here, with coarsely granular and densely punctured frontal walls. Secondary orifice semicircular, with an elliptical spiramen immediately proximal to it; avicularia paired, lateral to spiramen and orientated distally or distomedially. Marginal avicularia were not found.

Family **Bifaxariidae** Busk, 1884

Bifaxariidae Busk, 1884: 79. Harmer, 1957: 859.

Bifaxaria Busk, 1884

Bifaxaria Busk, 1884: 79. Harmer, 1957: 860.

Bifaxaria submucronata Busk, 1884

Fig. 11C

Bifaxaria submucronata Busk, 1884: 80, pl. 13 (fig. 1).
Bifaxaria submucronata: Harmer, 1957: 861, pl. 57 (figs 1–3, 19, 22).

Material

Station SM 60, a single damaged internode.

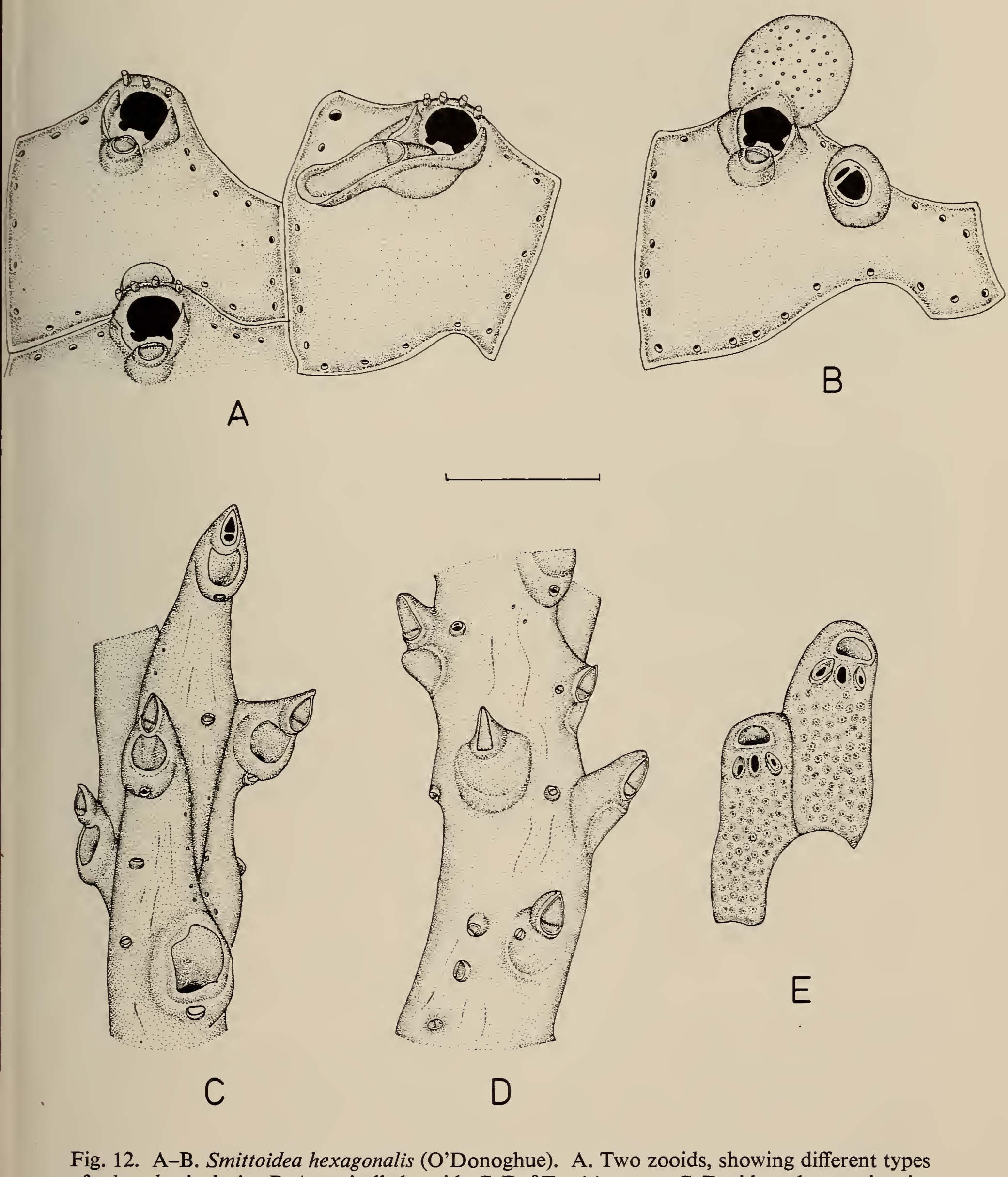

Fig. 12. A–B. *Smittoidea hexagonalis* (O'Donoghue). A. Two zooids, showing different types of suboral avicularia. B. An ovicelled zooid. C–D. *?Turritigera* sp. C. Zooids at the growing tip. D. Older zooids with occluded orifices. E. *Adeonella* sp. Two young zooids. Scale = 0,5 mm.

Description

Colony erect, jointed. Internodes biserial; zooids in alternating back-to-back sequence, vase-shaped. Primary orifice terminal, obscured by a prominent, projecting proximal lip. Frontal wall smooth, with a single series of marginal pores, and a variable number of pores in longitudinal sequence frontally. Epitheca thick, clearly visible. A single, small adventitious avicularium situated on each side of the orifice, mandible semicircular, directed distolaterally.

Bifaxaria ?longicaulis Harmer

Fig. 11A–B

Bifaxaria longicaulis Harmer, 1957: 863, pl. 57 (figs 5–6, 14–15, 17, 20).

Material

Station SM 31, a single damaged colony.

Description

Colony erect, jointed and branching; anchored by long branching rhizoids, locally swollen and forming inflated, tuber-like structures. Internodes slender, biserial, zooids in alternating, back-to-back sequence. Primary orifice sub-terminal, circular, without a pronounced peristome. Frontal wall smooth, fine-grained, with sporadic frontal and marginal pores. Adventitious avicularia small, lateral to orifice or on proximal frontal wall of adjacent zooid.

Remarks

The solitary specimen obtained represented the proximal portion of an old and thickened colony. Details of zooidal morphology were unclear, but in broadest terms they corresponded most closely to *B. longicaulis* Harmer. In particular, the curious swellings of the rootlets are described by Harmer (1957) for this species. However, the condition of the specimen prevents confident identification with the latter species.

Family **Cleidochasmatidae** Cheetham & Sandberg, 1964

Cleidochasmatidae Cheetham & Sandberg, 1964: 1032.

Cleidochasma Harmer, 1957

Cleidochasma Harmer, 1957: 1038. Cook, 1964*a*: 11.

Several species of this genus have the ability to colonize very small substrata, and some appear to be confined to this type of environment. Lunulitiform colonies of *C. mirabile* were described by Harmer (1957: 1045, pl. 71 (figs 15, 17–18), fig. 113) from the East Indies, and the minute, encrusting *C. rotundorum* (Norman) was described by Cook (1964*a*: 20, pl. 1 (fig. 2), fig. 5B–C) from Madeira. Another similar encrusting species, *C. gilchristi* Cook, is known from South Africa (see Cook 1966: 212, pl. 1 (fig. 1A–B), fig. 2A–B). *C. gilchristi* was reported from 101–275 metres off Durban, but has not been found in the present

South African collections, its place being taken by colonies of *C. protrusum*, which is otherwise known from shallow water.

Cleidochasma protrusum (Thornely, 1905)

Gemellipora protrusa Thornely, 1905: 119, pl. 7.
Cleidochasma protrusum: Harmer, 1957: 1040, pl. 71 (figs 1–4), fig. 112.

Material

Stations SM 23, SM 41.

Description

Colony encrusting, often on small substrata. Zooids with marginal frontal pores and lateral and distal septulae. Orifices with a deep, triangular sinus and large, paired condyles. Adventitious avicularia suboral, derived from marginal septula, mandible acute, orientated laterally or proximally. Ovicells prominent, tuberculate, hyperstomial, not closed by the operculum.

Remarks

C. protrusum has a very wide bathymetrical and geographical range and is found on a variety of substrata. The colonies from South Africa are very small and encrust sand grains. They range in diameter from 0,90–2,00 mm and comprise from 6 to 35 zooids. Ovicells are present in colonies with only 8 zooids. The specimens described by Harmer (1957) were much larger (diameter 10 mm) and originate on shell fragments 3–4 mm in diameter. The colonies consist of multilaminar spheres formed by successive overgrowth, and as many as 16 zooid layers are present.

Distribution

C. protrusum has also been found in shallow-water sediments of Upper Miocene age from the Chake clay beds of Pemba, Zanzibar (British Museum Collections). The Recent distribution extends from the Indo-West-Pacific through the Indian Ocean to Mauritius and east and South Africa.

Family **Smittinidae** Levinsen, 1909

Smittinidae Levinsen, 1909: 335. Hayward & Ryland, 1979: 98.

Smittoidea Osburn, 1952

Smittoidea Osburn, 1952: 408. Hayward & Ryland, 1979: 108.

Smittoidea ?hexagonalis (O'Donoghue)

Fig. 12A–B

Smittia hexagonalis O'Donoghue, 1924: 46, pl. 3 (fig. 15).

Material

Station SM 86.

Description

Colony encrusting. Zooids broad and flat, quadrate or hexagonal, separated by raised sutures; 0,7–0,9 mm long by about 0,6 mm broad. Primary orifice orbicular, with a short, quadrate lyrula occupying about half the proximal border; paired, blunt and downcurved, lateral condyles present. Orifice surrounded laterally by a thin, raised peristome, incomplete proximally where it incorporates a small avicularium; mandible semicircular, directed proximally. Three or four distal oral spines present. Frontal wall smooth, thin and almost flat, with distinct marginal pores. Frontal avicularia occur sporadically, similar to the suboral type but larger. Frequently the suboral avicularium is replaced by an elongate, parallel-sided avicularium which extends from the proximal edge of the orifice laterally, almost to the edge of the zooid, the peristome being deformed in the process. Ovicell hyperstomial, thin, hyaline, with numerous small frontal pores.

Remarks

A single small colony only was found. In most respects it is closest to O'Donoghue's species, described from eastern South Africa, but more information on the South African Smittinid fauna is required before a firm identification may be made.

Family **Tessaradomidae** Jullien, 1903

Tessaradomidae Jullien, 1903: pl. 14. Hayward & Ryland, 1979: 242.

Tessaradoma Norman, 1869

Tessaradoma Norman, 1869: 309. Lagaaij & Cook 1973: 494. Hayward & Ryland, 1979: 242.

Tessaradoma bispiramina sp. nov.

Fig. 13A–D

Material

Holotype: SAM–A26296, station SM 86, 27°59,5′S 32°40,8′E, 550 m.
Other material: stations SM 23, SM 85, SM 103.

Description

Colony attached by an encrusting base, erect, cylindrical, branching irregularly; branches composed of triple whorls of zooids, tapered distally, thickening steadily by continuous frontal calcification. Typically producing paired lateral branches, at right angles to the main stem; all branches tending to curve distally. Colonies up to 1,5 cm tall, with maximum width of 2 mm. Zooids oval, boundaries marked by distinct sutures. Frontal wall thick, vitreous, with tessellated surface, distinct marginal pores present. Primary orifice orbicular, obscured by a tall, cylindrical peristome—frequently broken short—at the base of which two tubular spiramina arise, developing separately, close together, on the outer, proximal side of the peristome. In older zooids the spiramina are covered by secondary calcification and appear to be enclosed within the peristome. Avicularia adventitious, single or paired, distolaterally situated on the frontal wall of the zooid, developing from the marginal pores; mandible semicircular, directed laterally or proximolaterally. Ovicell broader than long, smooth and imperforate, opening into the peristome; completely obscured by development of the peristome and continued secondary calcification. The ovicell is apparent only at the growing tips, or in broken areas of the colony.

Etymology

Spiraculum (L)—an air-hole, referring to the paired spiramina of this species.

Remarks

With continued calcification the boundaries of the zooids become indistinct, sutures are increasingly undulated and wander over large areas of the colony. Orifices are deeply immersed, hiding the characteristic doubled spiramen, and there is a proliferation of small adventitious avicularia. The triple zooid whorls and the doubled spiramen distinguish *T. bispiramina* from other described species of *Tessaradoma.*

Measurements (means of 10 values) in mm

Lz	lz
0,8	0,4

Tessaradoma circella sp. nov.

Fig. 13E–H

Material

Holotype: SAM–A26313, station SM 103, 28°31,7′S 32°34′E, 680 m.
Other material: stations SM 16, SM 86, SM 92.

Description

Colony erect, slender, attached by a narrow, ring-shaped base, encircling hydroid stems; branching irregularly, up to 1 cm long in material collected, with a maximum width of 0,5 mm. Zooids in alternating; back-to-back pairs; elongate, oval, separated by raised sutures with a deep peristome constituting approximately half the zooid length. Frontal wall gently convex, smooth, with distinct marginal perforations; a short, tubular spiramen medially sited at the base of the peristome, in the apparent middle of the zooid. Peristome transversely oval. Avicularia adventitious, small, lateral, developed along the margins of the zooids, proximal to the peristome, apparently developing from the marginal pores; at least two, but up to six or more per zooid, mandible short, semicircular, acute to the frontal plane of the zooid and directed laterally. Ovicell broader than long, smooth surfaced and imperforate, opening into the peristome; rarely clearly visible, usually immersed and hidden by the peristome.

The colony becomes progressively smoother, and zooid outlines indistinct, with continued secondary calcification. The primary orifice is deeply immersed and the peristomial opening lies almost completely flush with the colony surface. Marginal pores are similarly deeply immersed but the spiramen remains prominent. Additional avicularia are developed as earlier ones are obliterated.

Etymology

Circellus (L)—a little ring, referring to the early astogeny of the colony.

Remarks

Of the 7 specimens with complete bases, 5 were attached to the stems of a hydroid, 1 old colony stump had become detached from its support, and 1 was attached to another colony of the same species. In all cases, the basal portion formed a narrow ring. Although both young and old colonies were found, the astogeny was not clear. The ring in the smallest colony appeared to be formed partly by a single zooid, perhaps the ancestrula, and partly by expansions from the zooids budded from it. Secondary calcification rapidly thickens the ring and early developmental stages are thus obliterated. *T. circella* is easily distinguished from other species of *Tessaradoma* by the very slender zooids, the length of the peristome, relative to total zooid length, and the median position of the spiramen. Its basal attachment is also unique.

Measurements (means of 10 values) in mm

Lz	lz
0,91	0,41

Family **Sertellidae** Jullien, 1903

Sertellidae Jullien, 1903: 57. Hayward & Ryland, 1979: 260.

Sertella Jullien, 1903

Sertella Jullien, 1903: 57. Hayward & Ryland, 1979: 260.

Sertella bullata sp. nov.

Fig. 15A–D

Material

Holotype: SAM–A26293, station SM 23, 27°44,4′S 32°42,8′E, 400–450 m.
Other material: stations SM 16, SM 41.

Fig. 13. A–D. *Tessaradoma bispiramina* sp. nov. A. Zooids at the tip of a colony. B. An ovicelled zooid. C. A group of young zooids, one with a developing spiramen. D. Part of an old thickened branch. E–H. *Tessaradoma circella* sp. nov. E. Zooids at the tip of a colony. F. Ovicelled zooids. G. The proximal part of an old colony, showing its ring-like base. H. The proximal part of a young colony, attached to a hydroid.
Scale = 0,5 mm for A–F, H; 1 mm for G.

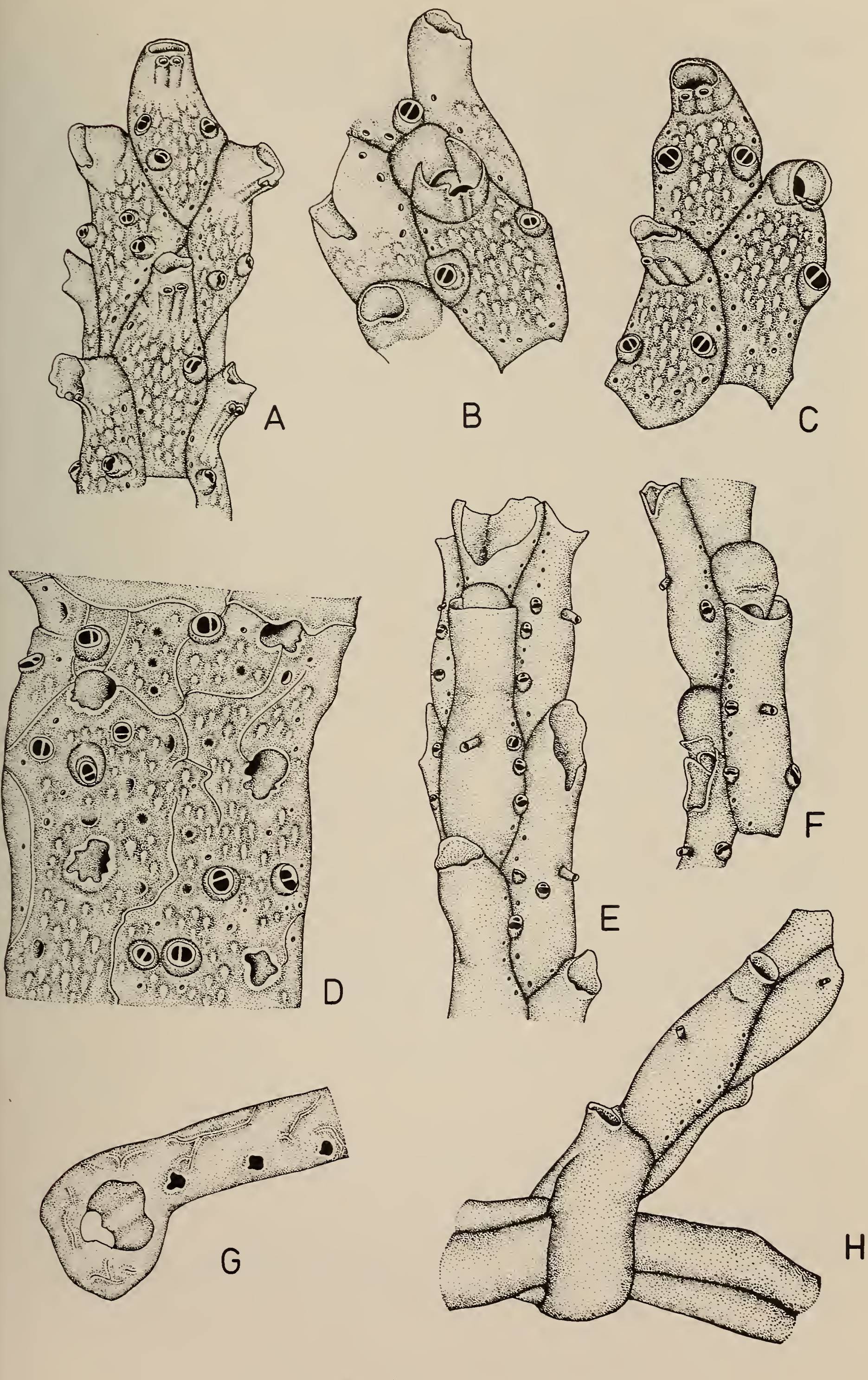

Fig. 13

Description

Colony erect, reticulate; trabeculae, up to 0,4 mm wide, composed of two alternating series of zooids, occasionally doubled where two trabeculae fuse; fenestrulae large, diamond-shaped, 1,5 mm long by 0,9 mm wide. Zooids oval, elongate, slightly convex, separated by shallow grooves, later partially immersed and less distinct. Frontal wall smooth, fine grained, with inconspicuous marginal pores, later partially covered by small granular papillae. Primary orifice broader than long, transversely oval, distal half minutely denticulate, proximal half gently concave between blunt lateral condyles. Peristome thin, erect, distal edge flared, deep, completely obscuring the orifice; a narrow median fissure extends the whole of its length, communicating with a small round pseudosinus proximally. Two short oral spines distolaterally, visible only in newly developed zooids. Adventitious avicularia present on different areas of each zooid, usually close to the margin, very numerous in older zooids; cystid inflated, rostrum fusiform, pivotal bar approximately median with a foramen on each side; mandible triangular, acute, variously orientated. There is little variation in size, although small individuals, with semicircular mandibles, occur rarely. Ovicell very large, almost as long as the bearing zooid, pear-shaped, broadest distally, slightly flattened frontally with a very narrow fissure extending almost the whole of its length. In the present material, ovicells seem to occur only on zooids immediately proximal to trabecular fusion, the ovicell being supported on the joint. Basal surface with numerous avicularia, and thickly covered with papillae.

Etymology

Bullatus (L)—inflated, referring to the ovicell.

Remarks

Species of *Sertella* are characteristic of the benthos of the outer continental shelf and slope in various parts of the world. Systematic problems are worsened by the often fragmentary nature of the material obtained, and earlier records are often difficult to corroborate. The Sertellidae (= Reteporidae) of the Indo-West-Pacific have been well monographed by Harmer (1934) but in most other regions they require considerable investigation. *Sertella bullata* may be distinguished from other described species by the relatively large size of the ovicell, the shape of the avicularia and its characteristically papillose surface.

Measurements (means of 10 values) in mm

Lz	lz
0,49	0,21

Reteporella Busk, 1884

Reteporella Busk, 1884: 126. Harmer, 1934: 572.

This genus was created by Busk (1884: 26) for a single species, *R. flabellata*, collected by the *Challenger* from Heard Island. The two species described below conform to Busk's, and later Harmer's (1934) diagnosis of the genus, but are distinctive in being bilaminate, with zooids on both sides of the flat branches.

Reteporella dinotorhynchus sp. nov.

Fig. 14A–D

Material

Holotype: SAM–A26305, station SM 23, 27°44,4'S 32°42,8'E, 400–450 m. Other material: station SM 41.

Description

Colony erect and branching, not reticulate. Branches flat and broad, up to 3 mm wide, largest unbranched fragment measuring 13 mm; bilaminar, zooids opening on both faces. Zooids oval to hexagonal, strongly convex and separated by deep grooves. Frontal calcification smooth and vitreous, with a few scattered, inconspicuous marginal pores. Primary orifice longer than broad, approximately bell-shaped, distal rim finely denticulate, posterior border gently concave below blunt, lateral condyles. Peristome low and thick, with a small mucro medio-proximally adjacent, on the right or left, to a shallow notch. Five or six tall, flattened and jointed (antenniform) spines around the distal and distolateral borders of the orifice. Adventitious avicularia sparsely distributed, occurring on the frontal wall immediately proximal to the peristome; cystid inflated, mandible semi-elliptical, acute to frontal surface and directed proximally. Vicarious avicularia present along the branch edges, often common, identical to adventitious type but larger. Ovicells were found only in the oldest specimens, only the lateral walls remained and nothing of their structure could be deduced. In the more proximal parts of the colony secondary calcification causes a thickening and smoothing of the colony surface, and adventitious avicularia are more frequent.

Etymology

Dinotos (G)—rounded, rhynchos (G)—a snout, referring to the avicularium.

Remarks

No complete colony was found, but a number of fragments, of both living and dead material, was obtained from each of the two stations.

Measurements (means of 10 values) in mm

Lz	lz
0,86	0,52

Reteporella clancularia sp. nov.

Fig. 14E–I

Material

Holotype: SAM–A26304, station SM 23, 27°44,4'S 32°42,8'E, 400–450 m. Other material: station SM 41.

Description

Colony erect, branching, not reticulate. Branches flat, narrow, commonly less than 2 mm broad, largest unbranched fragment 8 mm long; bilaminar, zooids opening on both faces of the branch. Zooids oval, convex, separated by deep grooves, distinct at the growing edges but later immersed. Frontal wall smooth, fine-grained, with a few small and inconspicuous marginal pores. Primary orifice longer than wide, bell-shaped, distal rim finely denticulate, proximal border concave below blunt lateral condyles. Peristome erect, thin, with a rounded notch proximally and frequently a small columnar avicularium adjacent to it; mandible semicircular. Six or seven slender, jointed (antenniform) spines on the distal border of the orifice. Avicularia numerous and varied, becoming more frequent in older parts of the colony. Small frontal avicularia present on most zooids, with semicircular mandible, often two or three in older zooids; enlarged avicularia, with broadly spatulate mandibles, may also occur. These large avicularia also occur consistently along the edges of the branch. Ovicell thin, hyaline, with a broad frontal fissure; prominent when newly developed, later immersed and obscured.

Etymology

Clancularius (L)—unknown, referring to the specific character correlations.

Measurements (means of 10 values) in mm

Lz	lz
0,64	0,29

Family **Celleporidae** Busk, 1852

Celleporidae Busk, 1852: 85. Hayward & Ryland, 1979: 274.

Turbicellepora Ryland, 1963

Turbicellepora Ryland, 1963: 34. Hayward & Ryland, 1979: 284.

Turbicellepora protensa sp. nov.

Fig. 15E–H

Material

Holotype: SAM–A26301, station SM 86, 27°59,5'S 32°40,8'E, 550 m.
Other material: stations SM 23, SM 41, SM 103.

Fig. 14. A–D. *Reteporella dinotorhynchus* sp. nov. A. Two young zooids with complete spines. B. Diagram of primary orifice. C. Later zooids, with marginal avicularia on right. D. Immersed orifices of old zooids. E–I. *Reteporella clancularia* sp. nov. E. Young zooids with complete spines. F. The branch edge, showing vicarious avicularia. G. Ovicelled zooids. H. Old zooids with immersed orifices. I. Diagram of primary orifice. Scale = 0,5 mm.

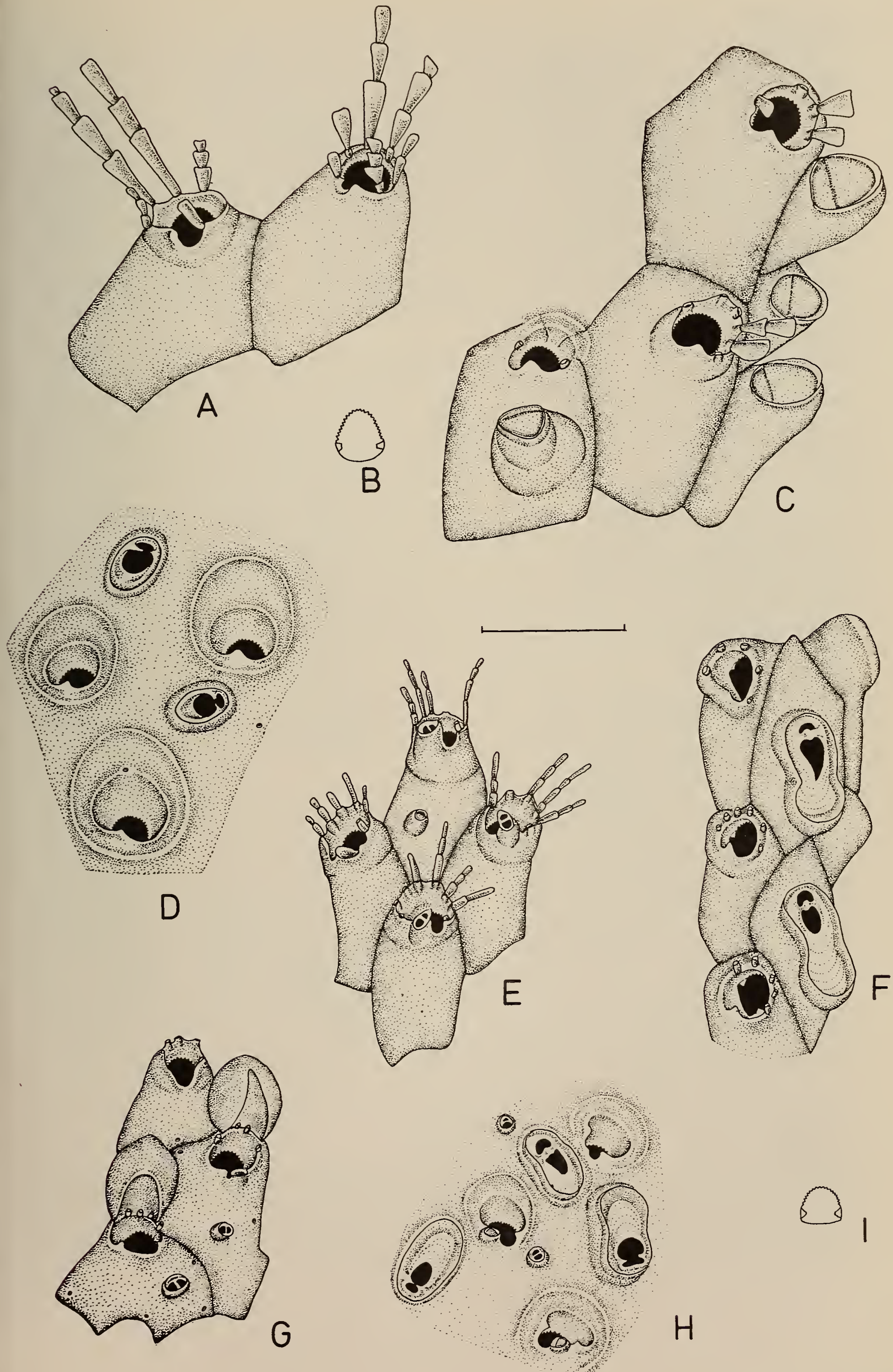

Fig. 14

Description

Colony attached by a small encrusting base, forming a flat, branching and spreading growth; branches slender, cylindrical and tapering, up to 2,5 mm thick, with a spread of 2,5 cm in the largest specimen. Zooids oval, strongly convex, in regular series at the distal ends of the branches, elsewhere randomly orientated as branches thicken by frontal budding. Primary orifice orbicular, with a V-shaped proximal sinus, encircled by a thin, erect peristome enclosing a small avicularium; mandible semi-elliptical, acute to frontal plane of zooid and directed laterally. Frontal wall smooth, finely granular, with small, widely-spaced marginal pores. Vicarious avicularia spatulate, palate with an oval foramen, pivotal bar very thin, without a columella. Ovicell spherical, smooth, with about ten small, round pores frontally.

As in all species of this genus, the appearance of the colony alters with age. Continuous frontal budding produces a multilaminar colony with orifices opening at all levels; the primary orifice becomes deeply immersed in older parts of the colony, but where the rate of frontal budding slows the peristomes are commonly worn or broken and the orifice has a more open appearance.

Colonies commence branching at an early stage and the form seems to be particular to the species. Nodular, massive colonies were not found and the open fan-like growth occurred in all the specimens found. Initially attached wholly to the substratum, the branches are independent of it; the actual point of attachment is very small and in the largest specimen was not apparent at all.

Etymology

Protensus (L)—extended, referring to the branching pattern of the colony.

Remarks

The genus *Turbicellepora*, and indeed a majority of the Celleporidae, presents severe systematic problems which will not be resolved without critical re-examination of described species, and of specimens of species with purportedly broad geographical ranges. Many of the Celleporidae reported from South African waters have been identified with European or north Atlantic species (e.g. O'Donoghue 1924; O'Donoghue & De Watteville 1944). Some of these reports may refer to the above species, which has not been independently described, as far as it is possible to judge, but without accurate descriptions and illustrations synonymy is impossible.

Fig. 15. A–D. *Sertella bullata* sp. nov. A. Young zooids, with numerous avicularia. B. An ovicellate zooid. C. Basal view of a branch. D. Diagram of primary orifice. E–H. *Turbicellepora protensa* sp. nov. E. A group of zooids. F. Later zooids, and vicarious avicularia. G. Ovicelled zooids. H. Typical form of the colony. Scale = 0,5 mm for A–G; 2 mm for H.

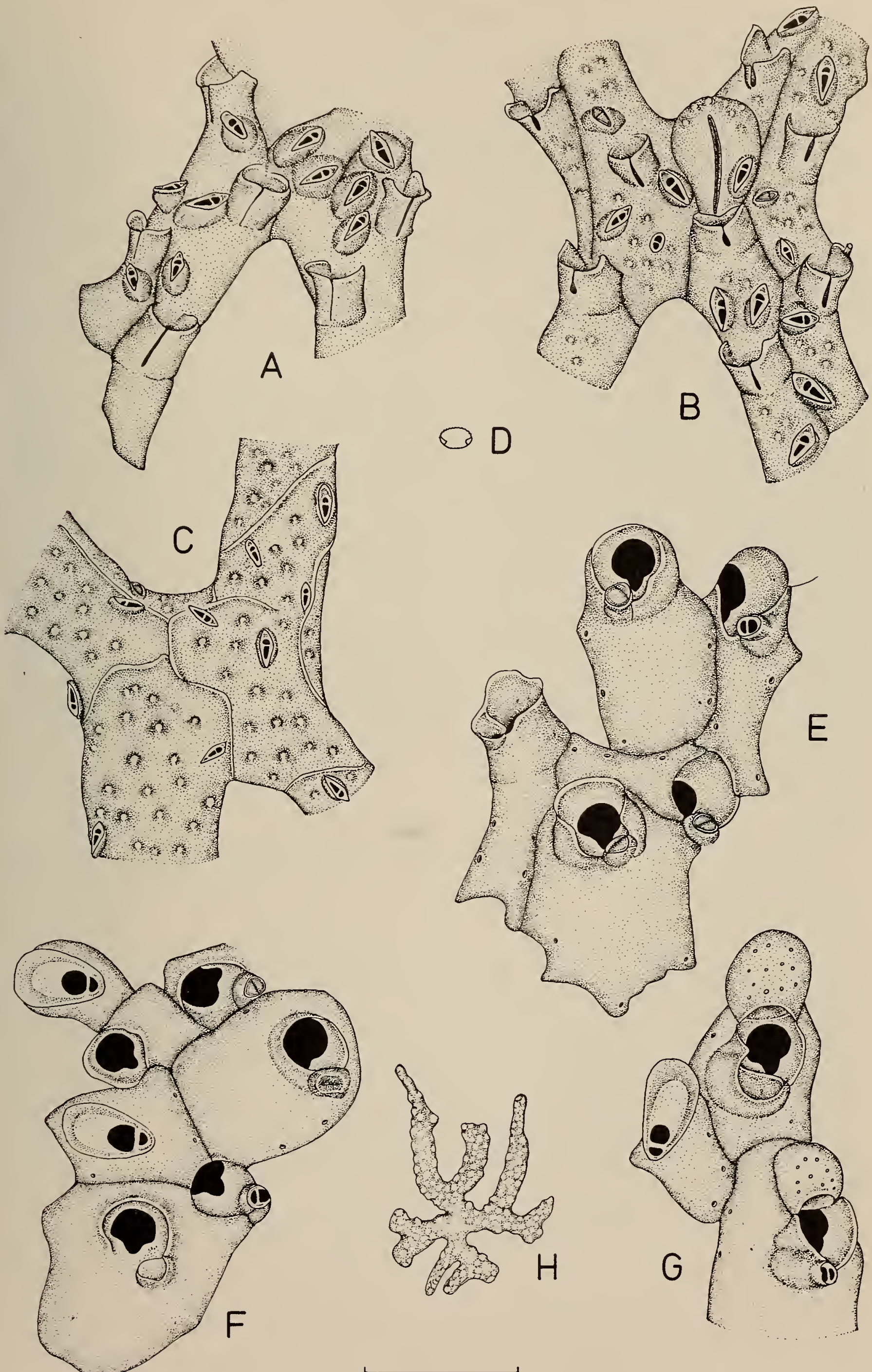

Fig. 15

Orifice dimensions (means of 20 values) in mm

Lor	lor
0,138	0,139

Turritigera Busk, 1884

Turritigera Busk, 1884: 129.

?Turritigera sp.

Fig. 12C–D

Material

Stations SM 16, SM 23.

Description

Colony erect and branching, composed of four longitudinal series of zooids, orifices opening alternately around the whole periphery. Zooids 0,7 to 1,1 mm long by about 0,3 mm broad, convex, boundaries indistinct. Primary orifice obscured by a tall, funnel-like peristome, curving out perpendicularly from the branch when undamaged. Peristomial orifice longer than broad, approximately quadrate in shape; an adventitious avicularium on its distal border with acute triangular mandible, directed distally. A smaller avicularium occurs on the proximal border of the peristome, with a minute semicircular mandible. Additional avicularia of the second type occur elsewhere on the frontal surface. Frontal wall thick and smooth with discontinuous longitudinal striations, small marginal pores present. Secondary calcification proceeds swiftly, giving a smooth, uniform surface to the colony. Orifices of the proximalmost zooids are obliterated, with only the distal avicularium remaining visible.

Remarks

Fragments of this curious species were recovered from two stations, but were insufficient to give a complete account of its morphology; none of the fragments bore ovicells, and the shape of the primary orifice could not be determined. *Turritigera* is represented by a single species, *T. stellata* Busk, recorded from the Patagonian shelf (Busk 1884; Moyano 1974) and the Cape of Good Hope (Busk 1884). The present species differs from *T. stellata* principally in having zooids disposed around the whole circumference of the branch, in the latter there is a defined basal surface with zooid orifices opening only on one side of the branch. The structure of the peristome and the type and distribution of avicularia suggests an affinity with *Turritigera*, but conclusive evidence will be supplied only by the collection of better material.

Family **Vittaticellidae** Harmer, 1957

Vittaticellidae Harmer, 1957: 765. Wass & Yoo, 1975: 286.

Costaticella Maplestone, 1899

Costaticella Maplestone, 1899: 9. Wass & Yoo, 1975: 288.

Costaticella carotica sp. nov.

Fig. 16

Material

Holotype: SAM–A26306, station SM 85, 27°59,5′S 32°40,8′E, 550 m.
Other material: stations SM 16, SM 23, SM 86.

Description

Colony erect, ramifying, composed of chains of single zooids, linked proximally and distally by chitinous, tubular nodes. Branching at irregular intervals, where a short daughter zooid is budded distolaterally from a normal zooid, and initiates a new chain. Rarely, the daughter zooid may bud a second series of zooids laterally, in addition to the distal series. Zooids elongate, vase-shaped; primary orifice lepralioid, with a straight or slightly convex proximal border. Frontal wall with an elliptical series of 8–13 small, round or irregular, fenestrae, often with faint sutures extending medially from them. Proximal to the orifice, half of the area enclosed by the fenestrae is apparently formed by the fusion of seven costae; distinct lateral and medial sutures are visible between them. Scapular chambers developed as short, squat avicularia, with triangular mandibles orientated parallel to the long axis of the zooid. Suprascapular chambers short; two infrascapular chambers on each side, elongate; each with two or three uniporous pore plates. Gonozooids were not present. The colony is anchored by bundles of chitinous rootlets arising from the basal surfaces and the infrascapular chambers of the lowest zooids.

Etymology

Caroticus (L)—stupefying, referring to the monotonous character correlations of the genus.

Remarks

The structure of the frontal wall, the shape of the orifice and the form of the infrascapular chambers suggest that this species is most appropriately placed in *Costaticella* Maplestone. It appears to be most similar to *C. benecostata* (Levinsen), described from southern Australia, but differs from it in its more prominent avicularia. The morphological complexities of this group of Ascophorans makes the evaluation of many early records extremely difficult However, *C. carotica* is certainly distinct from any of the Australian species recently described or redescribed by Wass & Yoo (1975), and is quite different from the few Vittaticellidae known from the east African coast.

Measurements (means of 20 values) in mm

Lz	lz
0,82	0,33

Fig. 16. Scanning Electron Micrographs. *Costaticella carotica* sp. nov. A. A single zooid. B. Daughter zooid budded from a maternal zooid. C. Enlarged view of the central area of the frontal wall. D. The proximalmost infrascapular chamber, showing uniporous pore plates. Scale = 0,092 mm for A; 0,07 mm for B; 0,0874 mm for C; 0,026 mm for D.

Family **Mamilloporidae** Canu & Bassler, 1927

Mamilloporidae Canu & Bassler, 1927: 9. Harmer, 1957: 887.

Anoteropora Canu & Bassler, 1927

Anoteropora Canu & Bassler, 1927: 10. Harmer, 1957: 888.

Colony lunulitiform, but anchored by basal rhizoids. Zooid series developed radially from a fan-shaped group of primary and secondary zooids derived from a single ancestrula. Zooids with greatly extended vertical walls, and small, hexagonal basal walls. Zooids communicating through septula, placed at the basal part of the zooid. Orifices large, usually with paired condyles. Avicularia, if present, interzooidal, regularly patterned. Ovicells large, hyperstomial, closed by the operculum, orifices of brooding zooids variously dimorphic.

Anoteropora latirostris Silén, 1947

Anoteropora latirostris Silén, 1947: 58, pl. 5 (figs 25–27), figs 49–50. Cook, 1966: 210.

Material

Stations SM 16, SM 23.

Description

Anoteropora with large avicularia placed laterally to the orifice of both autozooids and brooding zooids.

Remarks

Anoteropora latirostris differs from *A. inarmata* (see below) in possessing avicularia, and from *A. magnicapitata*, the other species found in the Indian Ocean, in having avicularia associated with the brooding zooids (see Canu & Bassler 1929: 476; Harmer 1957: 888). *A. smitti* (Calvet), known from only two colonies from the Cape Verde Islands, is very similar to *A. latirostris* (Cook 1966: 211, 1968: 183).

Distribution

A. latirostris has been reported from the Red Sea and the Western Indian Ocean to the East Indies, from depths ranging from 30 to 450 m.

Anoteropora inarmata Cook

Figs 17C, 18C

Anoteropora inarmata Cook, 1966: 211, fig. 1.

Material

Stations SM 53, SM 60.

Description

Anoteropora without avicularia. Frontal shield with a reticulate pattern of calcification. Operculum of brooding zooids with a subperipheral sclerite which is straight distally.

Remarks

A. inarmata was originally described from a single colony from Zanzibar. The additional colonies from South Africa show the numerous basal rhizoids, and the pattern of early astogeny. The colonies from station SM 60 are all regenerated from fragments.

The zooids are very deep, and the basal part of each one forms a small compartment which communicates distally and laterally with other zooids. Basally, the compartment walls make a pattern of hexagonal partitions, similar in appearance to those of *Cupularia guineensis* (Cook 1965*a*: 170). The compartments are not kenozooidal, however, and the structure of *Anoteropora* is fundamentally different from that of the Cupuladriidae (Håkansson 1973). The rhizoids are numerous (Lr 0,30 mm, lr 0,04 mm) and originate from a small septulum at the distal end of each basal zooid hexagon.

The investing cuticle appears to be distended above the calcification of the frontal shields and ovicells.

Distribution

A. inarmata occurs from Zanzibar to eastern South Africa, from a narrow bathymetrical range, 720–810 m.

Family **Orbituliporidae** Canu & Bassler, 1923

Orbituliporidae Canu & Bassler, 1923: 186. Cook & Lagaaij, 1976: 349.

The budding patterns of the colony forms occurring in both the Orbituliporidae and Conescharellinidae (see below) were described by Cook & Lagaaij (1976). Colonies are constructed of an ancestrular complex including a kenozooidal rooting element. In the genera *Batopora* and *Lacrimula*, *Conescharellina* and *Trochosodon*, all budding is frontal, and there is no zone of astogenetic repetition. Colonies are inferred to be orientated with the ancestrular, adapical region anchored in the sediment by one or more rhizoids, and with the proliferal, antapical region, where new zooid buds are formed, facing upward. The conventional representation of these colonies with the adapical region upward is therefore the reverse of the living orientation (see Figs 17, 20).

Cook & Lagaaij (1976) also discussed the combination and correlation of character states which were variously shared among species nominally assigned to *Batopora*, *Lacrimula* and *Conescharellina*. The type species of these genera

Fig. 17. A. *Heliodoma implicata* Calvet. Colony from frontal side, inferred to be uppermost in life, showing setiform avicularian mandibles. ×21. B. *Setosellina roulei* Calvet. Colony encrusting sand grain, showing setiform avicularian mandibles. ×16. C. *Anoteropora inarmata* Cook. Basal side of colony, showing rhizoids. ×7. D. *Batopora nola* sp. nov. Lateral view of holotype colony, showing adapical rhizoid. ×24. E. *B. lagaaiji* sp. nov. Lateral view of holotype colony, showing adapical rhizoid. ×24.

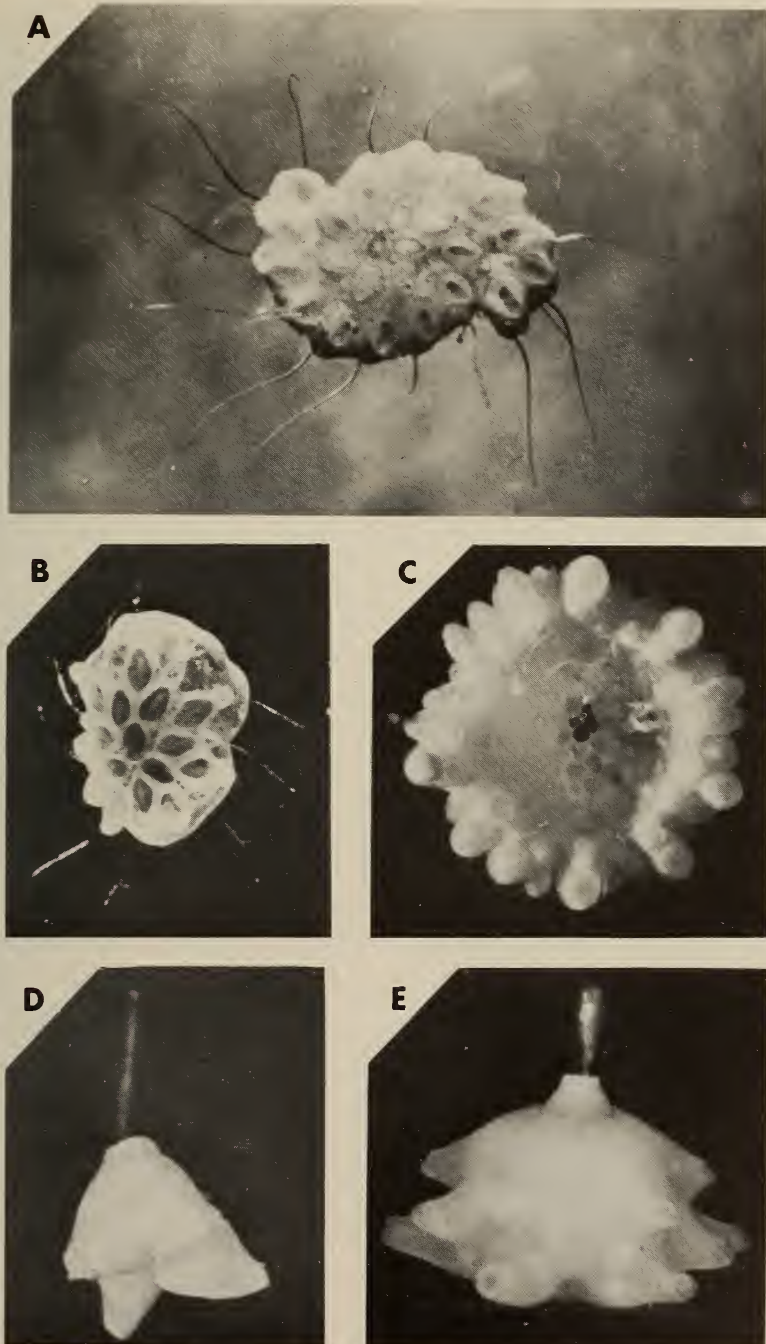

Fig. 17

differ in many characters, but an increasing series of species has been found which has reduced the overall differences among generic groupings belonging to the two families.

Batopora Reuss, 1867

Batopora Reuss, 1867: 233. Cook & Lagaaij, 1976: 349.

There are a few correlated character states which are used here to distinguish Recent species, at least, of *Batopora* from those of *Lacrimula*. The existence of living forms of *Batopora* was unknown until relatively recently, and the increasing numbers of fossil and living species of both *Batopora* and *Lacrimula* are the direct result of examination of sea-bottom sediments. Until many more samples have been analysed, it is advisable to delay revision of genera, and both *Batopora* and *Lacrimula* are retained here.

Species of *Batopora* have a single, relatively undifferentiated adapical rooting kenozooid which may become immersed as a 'pit', in contrast to the kenozooidal complex of *Lacrimula*. The peristomial ovicells are probably not closed by the operculum, also in contrast to those of *Lacrimula*. The primary orifice does not appear to have any condyles.

Batopora murrayi Cook, 1966

Figs 18F, 20A

Batopora murrayi Cook, 1966: 216, pl. 1 (fig. 3A–B). Cook & Lagaaij, 1976: 329, pl. 1 (fig. 2).

Material

Stations SM 16, SM 23, SM 32, SM 53, SM 60, SM 78, SM 86.

Description

Colonies small (1,60–3,40 mm in diameter), and rather flat. Ancestrular area with a central or eccentric rooting kenozooid, slightly raised at first, becoming immersed in a 'pit'. Whorls of four to five zooids budded alternately and becoming irregularly direct later in astogeny. Secondarily budded, small kenozooids and avicularia developing late in astogeny. Mandibles rounded, slung on paired condyles. Zooidal primary orifices straight antapically, peristome elongated and tubular in proliferal region, secondary orifices rounded. Ovicells very large, producing swollen peristomes in the proliferal zooids.

Remarks

Two colonies from station SM 16, with 30 and 12 zooids respectively, each have a delicate rhizoid (Lr 1,00 mm, lr 0,20 mm) originating from the adapical

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Fig. 18. Scanning Electron Micrographs. A. *Heliodoma implicata* Calvet. ×46. B. *Setosellina roulei* Calvet. ×37. C. *Anoteropora inarmata* Cook. Frontal side of colony, note ovicells. ×8. D. *Batopora lagaaiji* sp. nov. ×29. E. *Lacrimula pyriformis* Cook. Zanzibar, BMNH 1965.8.24.12. ×30. F. *B. murrayi* Cook. ×12.

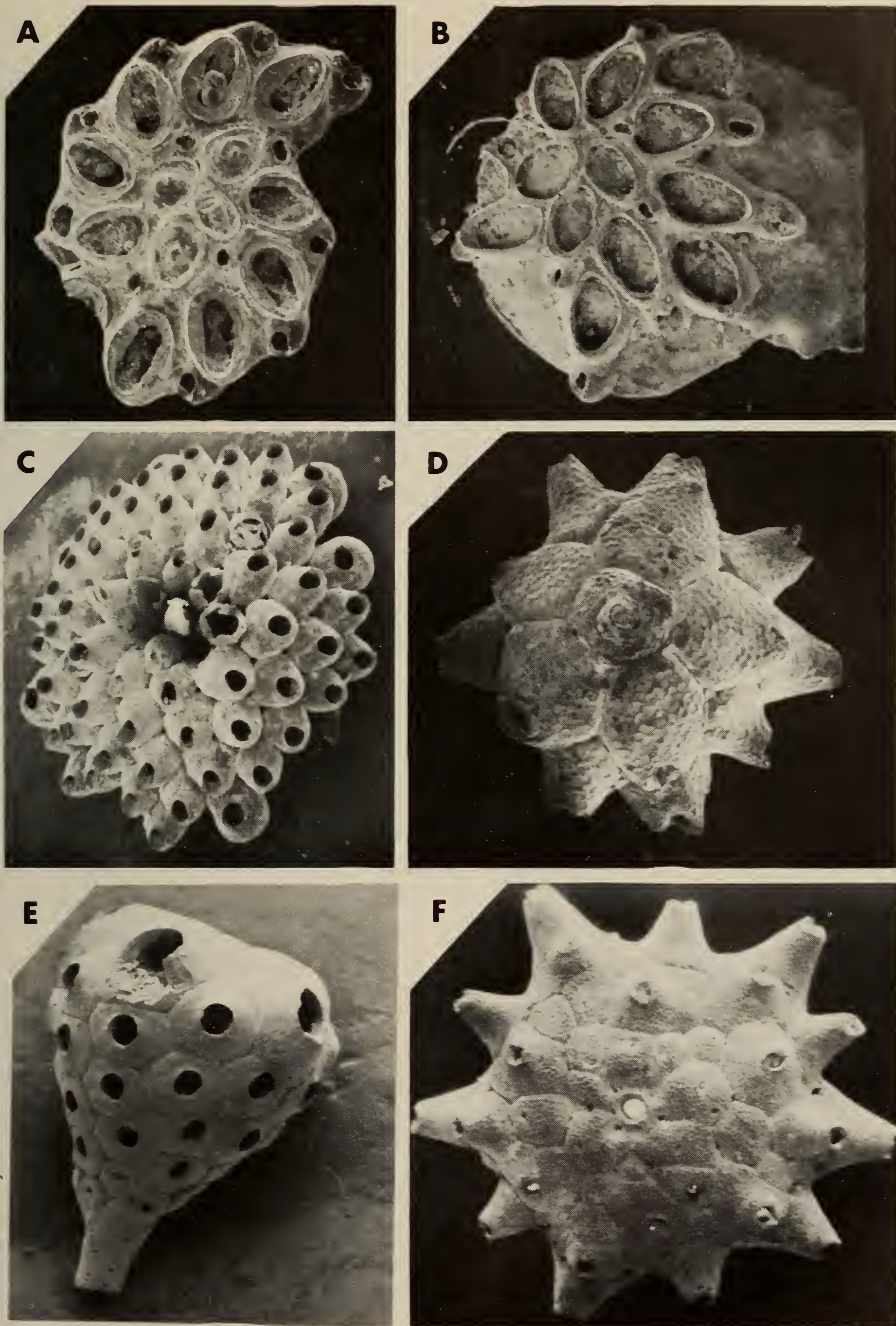

Fig. 18

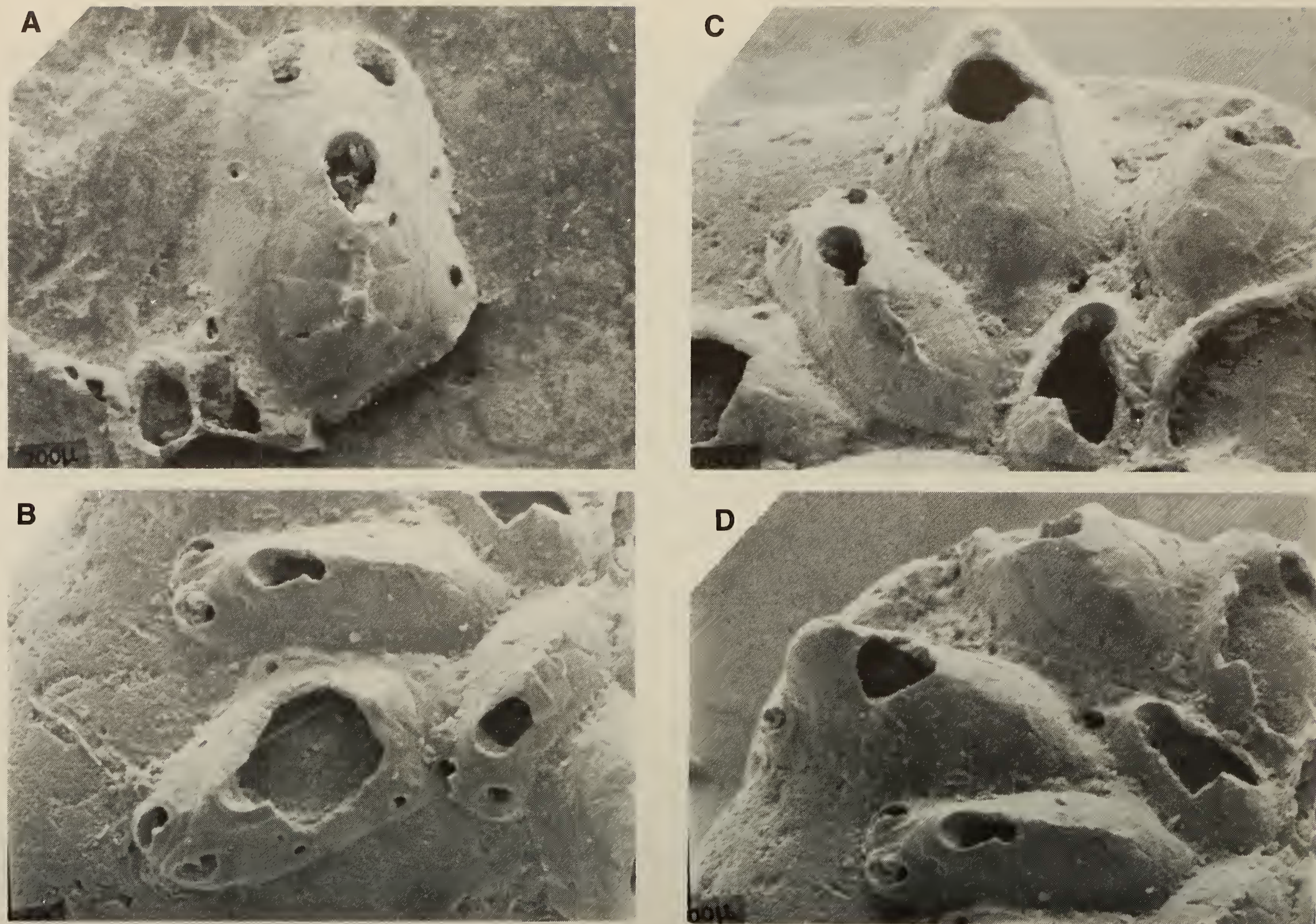

Fig. 19. Scanning Electron Micrographs. *Inversiscaphos setifer* sp. nov. A. Zooid showing frontal shield, lateral septula and paired, distal avicularia. ×112. B. Ancestrula (right) and some subsequent zooids showing budding pattern. Note asymmetrical avicularian condyles. ×90. C. Frontal-proximal view of brooding zooid (centre). ×90. D. Lateral view of brooding zooid (left). ×90.

kenozooid. Many of the colonies were alive when collected, and the dark coloured viscera are visible through the peristome walls. Uncalcified buds, appearing as 'bubbles' of cuticle are present in the proliferal region.

Distribution

B. murrayi was first described from Zanzibar, from a depth of 805 m, and subsequently reported from Fiji, from 384 m.

Batopora lagaaiji sp. nov.

Figs 17E, 18D, 20C

Material

Holotype: SAM–A26297, station SM 53, 26°51,5'S 33°12,5'E, 720 m.
Other material: stations SM 16, SM 31, SM 60, SM 69.

Description

Colonies very small (1,80–2,20 mm in diameter, 1,30–1,50 mm high). Adapical rooting kenzooid prominent, surrounded by five proximally directed primary zooids. Subsequent whorls are regularly composed of five alternating zooids. Small, antapical axial kenozooids present. Avicularia absent. Ovicells very large, peristomes of brooding zooids inflated but not curved.

Etymology

The species is named for the late Dr Robert Lagaaij, who initiated recent work on these minute bryozoan colony forms.

Remarks

B. lagaaiji differs from *B. murrayi* in the budding pattern and the absence of avicularia, and from *B. nola* (see below), by the number of zooids in each whorl. The holotype colony from station SM 53 has a rhizoid (Lr 0,40 m, lr 0,10 m) emanating from the adapical kenozooid.

The differences between *B. lagaaiji* and *B. nola* are small but consistent, and stem from the astogenetic pattern. Colonies of both species live under similar conditions and even occur in the same sample (SM 16). The rooted mode of life, and rigid, highly integrated early astogenetic budding pattern of conescharelliniform colonies, both make it unlikely that differences are attributable to microenvironmental (intracolony) influences. The number of zooids in each whorl is therefore regarded as genetically determined and as a specific difference between the two taxa (see below).

Measurements in mm

Lk 0,25–0,30	Lz,^{1} 0,70	lz^1 0,60
lk 0,32–0,38	lz^2 0,50	lz^3 0,40
lk aperture 0,10–0,20	lov 0,36–0,40	
l secondary orifice 0,14		

Batopora nola sp. nov.

Figs 17D, 20B, 21A

Material

Holotype: SAM–A26298, station SM 16, 27°33'S 32°44,6'E, 376–384 m. Other material: stations SM 16, SM 23, SM 41, SM 86.

Description

Colonies elongated, very small (0,90–1,10 mm in diameter, 0,80–1,00 mm high), shaped like a small handbell. Adapical rooting kenozooid large and prominent, surrounded by four proximally directed primary zooids. Subsequent whorls of four zooids alternating, orifices directed antapically and laterally. Small, antapical axial kenozooids present. Avicularia absent. Ovicells large, peristomes of brooding zooid curved adapically.

Etymology

Nola (L)—a little bell, referring to the shape of the colony.

Remarks

The peristomes of the autozooids are elongated and directed antapically, distinguishing colonies from those of the superficially similar species, *Lacrimula pyriformis* (see below). Brooding zooids are present in colonies of only twelve zooids; the peristomes are strongly curved adapically. One of the colonies (holotype) from station SM 16 has a rhizoid (Lr 0,80 mm, lr 0,06 mm) emanating from the adapical kenozooid.

Measurements in mm

Lk 0,30–0,33	Lz^1 0,50–0,53	lz^1 0,40–0,42
lk 0,35–0,40	Lz^2 0,30–0,35	lz^2 0,30–0,33
lk aperture 0,10	lov 0,25–0,30	
1 secondary orifice 0,06–0,07		

Lacrimula Cook, 1966

Lacrimula Cook, 1966: 217. Cook & Lagaaij, 1976: 355.

The genus was introduced for *L. burrowsi* Cook which was reported from depths of 101–207 m from Zanzibar and South Africa (Cook 1966: 218, pl. 2 (figs 2–4) fig. 4A). *L. burrowsi* has large colonies (1,0–2,0 mm in diameter, 2,8–3,2 mm high), and differs from *L. pyriformis* in the characters of the adapical region and the ovicells.

Lacrimula pyriformis Cook, 1966

Figs 18E, 20D

Lacrimula pyriformis Cook, 1966: 219, pl. 2 (fig. 1), fig. 4B. Cook & Lagaaij, 1976: 342, pl. 5 (fig. 3), pl. 6 (fig. 5).

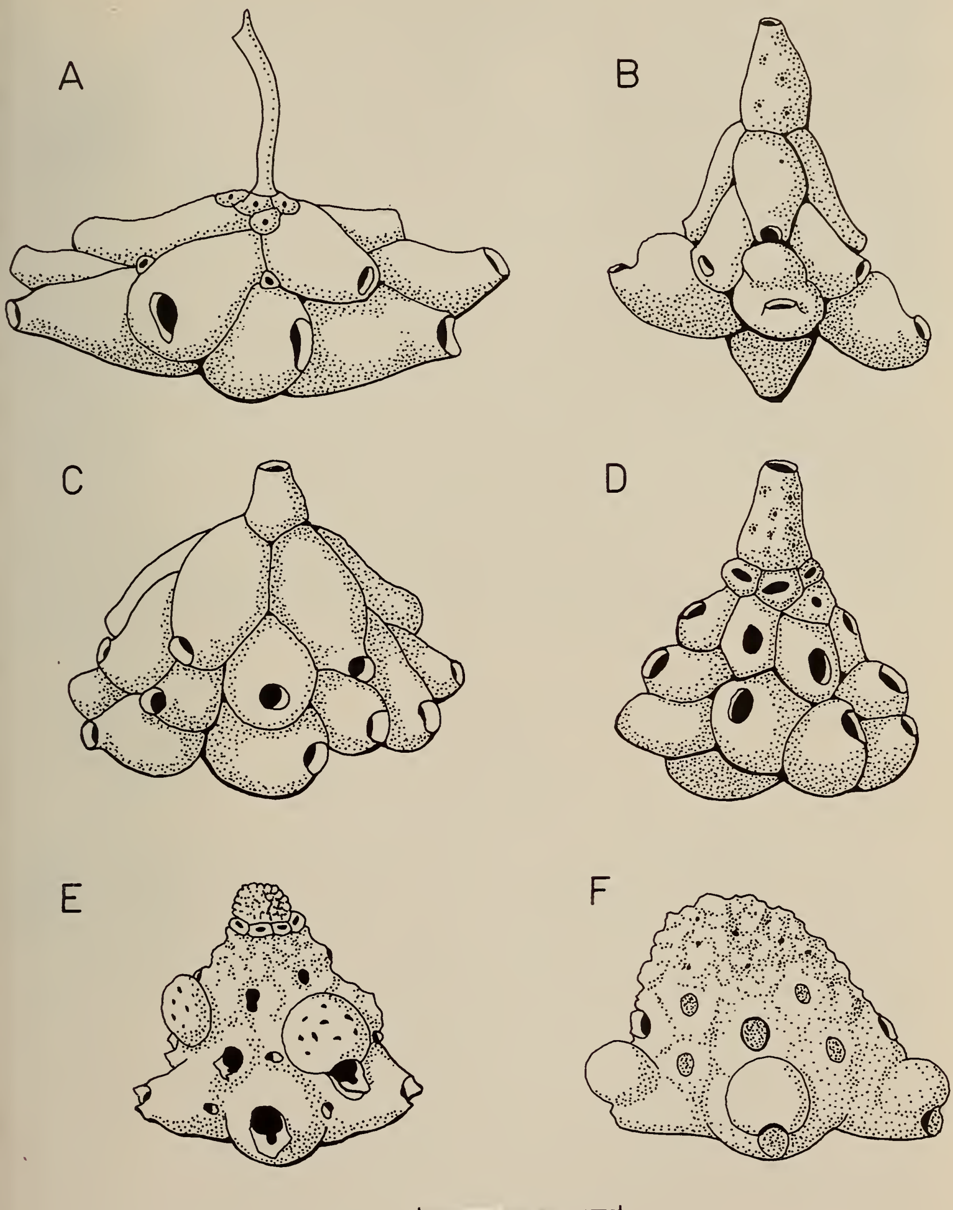

Fig. 20. Sketches of conescharelliniform colonies, orientation in life the reverse of that shown. A. *Batopora murrayi* Cook. Note rhizoid arising from adapical 'pit'. B. *B. nola* sp. nov. C. *B. lagaaiji* sp. nov. D. *Lacrimula pyriformis* Cook. E. *Conescharellina africana* Cook. F. *Trochosodon* sp. Scale = 1 mm.

Material

Stations SM 1, SM 16, SM 23, SM 86.

Description

Colonies very small (0,8–1,5 mm in diameter, 1,0–2,2 mm high). Adapical kenozooidal complex with a ring of secondarily budded avicularia. Whorls of four zooids alternating, peristomes not elongated. Ovicells hyperstomial, closed by the operculum, frontal wall with a row of subpheripheral pores.

Remarks

Colonies of *L. pyriformis* are superficially similar to those of *B. nola*. They differ in the nature of the adapical region and ovicell, in the area of exposed frontal shield, and in the overall size of zooids. Colonies of comparable size will include 16 zooids in *L. pyriformis*, but only 12 zooids in *B. nola*. This difference is a function of the angle of zooidal axes to colony axis and is regarded as genetically determined. Zooid peristomes are not elongated and those of the brooding zooids are not curved adapically. One colony, from station SM 16, has a rhizoid originating from the adapical kenozooid (Lr 0,80 mm lr 0,06 mm).

Distribution

L. pyriformis was originally reported from Zanzibar, from a depth of 310 m.

Family **Conescharellinidae** Levinsen, 1909

Conescharellinidae Levinsen, 1909: 308. Harmer, 1957: 722.

Conescharellina d'Orbigny, 1852

Conescharellina d'Orbigny, 1852: 446. Harmer, 1957: 726.

Colonies have an adapical ancestrular region with secondarily budded kenozooids, heterozooids and extrazooidal tissue, including special 'rootlet pores'. Zooids are budded frontally in alternating or direct rows, and surrounded by regularly patterned, interzooidal avicularia. Primary zooid orifices with a distinct sinus, secondary orifices with a raised lateral peristome. Ovicells hyperstomial, prominent, not closed by the operculum.

Conescharellina africana Cook, 1966

Figs 20E, 21B

Conescharellina africana Cook, 1966: 214, pl. 1 (fig. 2A–B), fig. 3.

Fig. 21. Scanning Electron Micrographs. A. *Batopora nola* sp. nov. Adapical view of colony, note large adapical kenozooid. ×90. B. *Conescharellina africana* Cook. Adapical view of colony. Note adapical kenozooidal area surrounded by avicularia, and large hyperstomial ovicell. ×90.

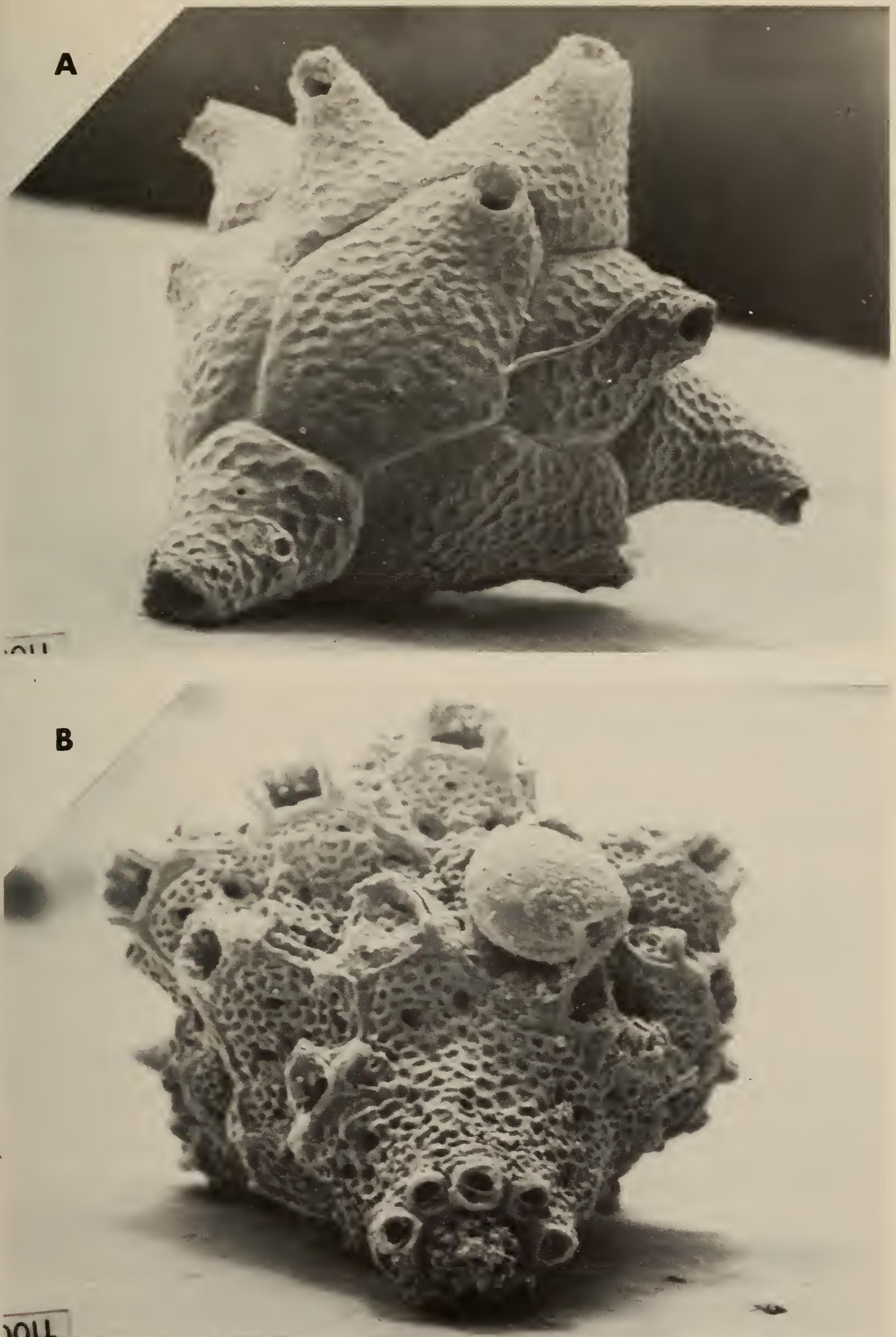

Fig. 21

Material

Stations SM 1, SM 16, SM 23, SM 41, SM 86.

Description

Colony very small (1,0–1,4 mm in diameter, 1,20–1,6 mm high) with alternating whorls of six zooids. Adapical area of kenozooids and extrazooidal tissue, surrounded by a circlet of eight to nine avicularia. Primary orifices with a narrow antapically directed sinus, peristome developed laterally and antapically. Frontal shield calcification reticulate, with large frontal septula. Avicularia paired, lateral, mandibles short and rounded, orientated laterally and slung on a complete bar. Occasionally an antapical avicularium, with antapically orientated mandible present. Ovicells globular, very prominent, developed by zooids of the third and fourth whorls late in astogeny, not present on proliferal region zooids. Ovicell frontal wall with large, irregular pores.

Remarks

The ovicells are not present in very young colonies, but are unusual in that they apparently develop later, on astogenetically early zooids only. *C. africana* also differs from other species in having an adapical region of extrazooidal tissue which is inferred to be the origin of rhizoids rather than distinct 'rootlet pores'.

Distribution

C. africana was originally described from South Africa, at a depth of 101 m.

Trochosodon Canu & Bassler, 1927

Trochosodon Canu & Bassler, 1927: 11. Harmer, 1957: 744.

The species assigned to this genus differ very little from those placed in *Conescharellina*, and require revision. *Trochosodon* has a generally more extensive, extrazooidal adapical region than *Conescharellina*; the primary orifices are not sinuate and the zooidal peristomes are elongated and tubular.

Trochosodon sp.

Fig. 20F

Material

Station SM 60.

Description

Colony very small (1,40 mm in diameter, 1,0 mm high); with twenty-four zooids. Adapical region domed, with 'rootlet pores'. Zooids in alternating series. Avicularia absent. Ovicells prominent, present on zooids of the proliferal region.

Remarks

One colony only of this distinctive species has been found. It greatly resembles unnamed specimens from Cape York, Queensland figured by Cook & Lagaaij (1976: 329, pl. 1 fig. 2). Examination of several other samples in the British Museum collections has revealed the presence of a complex of fossil and Recent forms from the east African area, and until these are analysed this species is left unnamed.

ORDER CTENOSTOMATA

The Ctenostomata are represented in these collections by one species only, a contrast to the deep-water faunas of the North-eastern Atlantic (D'Hondt 1975*b*; Hayward & Ryland 1978; Hayward 1978*a*, 1978*b*) which have recently been shown to include substantial numbers of new or little-known species.

Family **Flustrellidridae** Bassler, 1953

Flustrellidridae Bassler, 1953: 33.

Neoflustrellidra d'Hondt, 1975*b*

Neoflustrellidra d'Hondt, 1975*b*: 320.

?Neoflustrellidra sp.

Material

Station SM 86.

Description

Colony erect, branching profusely by dichotomy. Zooids elongated, arranged in alternating biserial series, back-to-back. Orifices not noticeably strengthened. Kenozooids absent.

Remarks

The material is fragmentary and shrunken. After treatment with trisodium phosphate solution, the zooids can be seen to be very similar in character and budding pattern to those of *N. schopfi* D'Hondt (1975*b*: 320, fig. 3), collected from the North Atlantic in 4 779 m. The orifices, however, lack any prominent, strengthened lower lip, and resemble those of *Bockiella angusta* Silén (see Hayward 1978*a*: 219), another erect, deep water ctenostome reported from more than 4 000 m from the North-eastern Atlantic, and 135–700 m from the western Pacific. Species of *Bockiella* usually have regularly disposed interzooidal kenozooids (Cook 1964*b*). Until further material becomes available this species is left unnamed.

ORDER CYCLOSTOMATA

Some Cyclostomata from east Africa, and including some species from deep water, have recently been described by Brood (1976). Specimens are rare in these collections, and most fragments are too worn for identification.

Family **Tubuliporidae** Johnston, 1838

Tubuliporidae Johnston, 1838: 247.

Idmidronea Canu & Bassler, 1920

Idmidronea Canu & Bassler, 1920: 784. Harmelin 1976: 181.

Idmidronea atlantica (Forbes, in Johnston, 1847)

Idmonea atlantica Forbes, in Johnston, 1847: 278.
Idmidronea atlantica: Harmelin, 1976: 182.

Material

Station SM 86.

Description

Colony erect, branching. Zooids arranged in alternating series of three to four facing frontally. Zooid peristomes connate, curved frontally. Basal surface of colony flat. Gonozooids frontal, slightly inflated, ooeciostome associated with the nearest, most median autozooid aperture.

Remarks

The complex of forms usually included in *I. atlantica* has a wide geographical and bathymetrical distribution, and some records have been revised by Harmelin (1976). The specimens from South Africa consist of 3 fragments, 1 of which has 3 gonozooids.

Family **Crisiidae** Johnston, 1847

Crisiidae Johnston, 1847: 282.

Crisia Lamouroux, 1812

Crisia Lamouroux, 1812: 183. Ryland, 1967: 272.

Crisia aff. *holdsworthi* Busk, 1854

Crisia holdsworthi Busk, 1886: 6, pl. 3 (fig. 2).

Material

Station SM 60.

Remarks

This species is represented by several specimens in a good state of preservation. Zooids are very attenuated, and the orifices alternating and widely spaced. No gonozooids are present, and further, fertile material is needed before a certain identity with Busk's species can be established.

DISCUSSION

General review of collection

The majority of species present in the *Meiring Naude* collections were cheilostomes, of which the number of anascan and cribrimorph species (20) was less than that of the ascophorans (28). The relatively low number of cyclostomes (2) is not unusual, but in view of the increasing number of ctenostome forms now known from deep water, it is surprising that only one species was found in this survey (see D'Hondt 1975*a*, 1975*b*; Hayward & Ryland 1978). Relative abundance in terms of numbers of colonies is not easy to estimate, except in the case of those species with very small, and therefore obviously discrete, colonies. *Setosellina* and *Batopora* are good examples. In these instances the numbers of anascan colonies (333) outweigh those of the Ascophora (173). The presence of such minute colonies was established only after careful examination of sediment samples. These species are very different in appearance from most other forms of Bryozoa, and for this reason may be overlooked when benthic samples are sorted. Further, because of their small size they are probably not recovered by collecting techniques other than those specifically designed to sample benthic substrata (see also Cook 1979). Harmelin (1977) has reported a diverse fauna of nineteen species, including several rare, free-living or rooted forms, from the Canary Islands region. The sample was collected accidentally during a plankton haul at 200 m over a sandy substratum, and the bryozoans were found only when the sediment was examined.

The shallow-water Bryozoa of South Africa have been reviewed by O'Donoghue (1957) and by Day *et al.* (1970), but require taxonomic revision and redescription. Generally, the deeper waters off South Africa have not been investigated before. Murray (1910) gave details of several expeditions to the Indian Ocean which were made in the last century. Of these, only the *Challenger* expedition (1872–6) and the *Valdivia* (Deutschen Tiefsee Expedition, 1898–9) have produced published descriptions of the Bryozoa. None of the *Challenger* stations from South Africa were deeper than 270 m (see Busk 1884: viii–xi), and none of the *Valdivia* stations exceeded 318 m (Hasenbank 1932). Both expeditions, however, made dredge hauls in very deep water from the South Atlantic and Indian Oceans.

Some Bryozoa from deep sediments collected by the *John Murray* off Zanzibar, and a collection made off Durban by J. D. F. Gilchrist in 1903–4, have been described by Cook (1966). Recently, D'Hondt & Redier (1977) have described some Bryozoa from the Kerguelen Islands, from depths of 29 to 270 m. The Cyclostomata of the Zanzibar area have been described by Brood (1976).

Colony form and environment

The correlation of bryozoan colony forms, or morphotypes, with environmental parameters such as substratum, turbulence and rate of sedimentation have been discussed by Lagaaij & Gautier (1965), Cook (1968), Labracherie (1973), Harmelin (1976) and Brood (1976).

The significance of colony morphotypes in ecological analyses of faunas depends on the degree to which mode of life (whether known or inferred) is reflected in colony structure. Some forms are distinctive and have a high correlation with certain environments (e.g. the lunulitiform and conescharelliniform morphotypes). Others are capable of inhabiting several types of environment (e.g. the cellariiform morphotype), and have a lower correlation. In addition, some species may display one morphotype early in astogeny and another in later stages of growth. The colony morphotypes particularly associated with sea-bottoms of mud, sand or foraminiferal ooze, where substrata available for larval settlement are restricted, have been reviewed by Cook (1979). In deep waters, turbulence and sedimentation rate are low, and substrata may be limited to the sediment particles alone. Briefly, species may be adapted to direct colonization of the sediments (primary fauna), or to general and/or specific utilization of other substrata, such as hydroids, which are themselves often primary colonizers (secondary fauna).

The morphotypes present in these collections fall into the following groups (see also Table 1):

Membraniporiform (4 species): encrusting, unilaminar, often on stones. Except for *Cleidochasma protrusum*, which in these collections has minute colonies encrusting sand grains, none of the species showing this morphotype are particularly adapted to either deep water or fine particled substrata.

Adeoniform and reteporiform (14 species): erect, rigid, branched, often bilaminar and arising from a small encrusting base. Colonies of some of these species originate from stones, but many have grown from flexible substrata such as hydroids or other, jointed Bryozoa. Colonies of *Tessaradoma*, and the 'reteporid' species generally, often occur on this type of substratum and are typical secondary fauna forms (Cook, 1968: 246).

Flustriform (3 species): erect, bilaminar, flexible, often anchored by rhizoids. The presence of rooting systems enables these species to colonize a range of habitats, but in deep water they may be part of either primary or secondary faunas.

Cellulariiform and Cellariiform (17 species): erect, flexible, jointed, branched, usually delicate and attached or anchored by rhizoids. Most of the species typical of abyssal faunas have these colony morphotypes. In shallow waters they are able to colonize unstable substrata, and it may be inferred that in deep water they are also a major part of the primary fauna.

Conescharelliniform (7 species): small, conical or globular, anchored by one or more rhizoids. This morphotype is typical of the primary fauna of fine sediments, and is generally, although not exclusively, associated with deep water. *Notocoryne* *cervicornis* is included among the conescharelliniform species, because of the small size of its colonies.

Lunulitiform (3 species): cup-shaped, unilaminar, either free living and supported by setiform avicularian mandibles, or anchored by basal rhizoids. These colonies have the classical 'sand-fauna' morphotype and are exclusively part of the primary fauna, although those with setiform avicularia are not generally found in deep waters (cf. setoselliniform). The forms which have basal rhizoids do not seem to have 'cleaning' setiform avicularia, a fact possibly related to the flexibility of their attachment and to the lower sedimentation rates and turbulence of deep waters.

Setoselliniform (3 species): discoid, very small, free living, supported or stabilized by setiform avicularian mandibles. This morphotype is exclusively associated with primary faunas, particularly of deep waters, and colonies are often of the same order of magnitude as the surrounding sediments.

The classification of colony morphotype is, of necessity, occasionally arbitrary. For example, *Notocoryne cylindracea* is here considered as a cellariiform species, as is the fragment of *Nellia* sp., although both differ markedly from *Cellaria* and related genera. *Turbicellepora protensa* has a very unusual and interesting growth form (p. 98), but has been placed in the reteporiform group, with which it appears to have functional similarities. Of the 30 species with morphotypes particularly associated with fine-particled sea-bottoms, 25 are known or inferred to have rhizoid systems, and 3 have setiform avicularian mandibles capable of stabilizing their very small colonies.

The sediments which have been examined (from stations SM 1, SM 16, SM 23, SM 31, SM 32, SM 41, SM 53, SM 60, SM 61, SM 67, SM 69, SM 78, SM 103, SM 109) vary considerably, both in the nature of the constituents and in the range of particle size (Tables 1, 3). There is no apparent correlation between sediment type and geographical or bathymetric distribution, or between sediment type and abundance and diversity of bryozoans. For example, the sediments at stations SM 31 and SM 61 consisted principally of very fine foraminiferan ooze, with a particle size of less than 1,0 mm. At stations SM 32 and SM 60, there was a preponderance of larger benthic foraminifera, with sand accreted tests, more than 5,0 mm in length or diameter. At station SM 41 there was hardly any sand, and the foraminifera were larger than 5,0 mm, whereas at SM 103 nearly all the sediment consisted of sand grains. Relatively large stones (> 20 mm diameter) were present in the samples from several stations (SM 23, SM 67, SM 103, SM 109) from a broad depth range. Similarly, large fragments (> 20 mm length) of coelenterate skeleton were abundant at stations SM 1, SM 23 and SM 41. Significant quantities of brachiopod shell and echinoderm test were present in sediments from stations SM 1, SM 41 and SM 60.

Generally, the abundance and diversity of bryozoans was highest at the two shallowest stations (SM 16, 376–384 m, and SM 23, 400–450 m), but almost as many species were present at station SM 41, from 880 m (Table 1).

TABLE 3

Abundance and diversity of minute colonies. The species are arranged in groups according to morphotype; stations are arranged in order of increasing depth. The number of colonies found is listed for each species at each station, together with the total number of colonies of all species, and the number of species. Sediment type and size is indicated for each station, classified as in Table 1.

				S	S	S	L	L	L	Co	Co	Co	Co	Co	Co	Co	M		
Station	Depth, m	Sediment size/type		*S. roulei*	*H. implicata*	*I. setifer*	*D. umbellata*	*A. latirostris*	*A. inarmata*	*N. cervicornis*	*B. murrayi*	*B. lagaaiji*	*B. nola*	*L. pyriformis*	*C. africana*	*Trochosodon* sp.	*C. protrusum*	No. of colonies	No. of species
SM 16	376–384	VF	Sh	10	138	37		1		7	12	2	30	22	10			269	10
SM 23	400–450	F	Gl		2		1	2			1		6	13	1		22	48	8
SM 86	550	—	—	5	15					6	1		1	1	2			31	7
SM 69	660	F	Sh	1	1							1						3	3
SM 103	680	F	S	6	43													49	2
SM 1	688	VF	Gl	3	11					7				1	3			25	5
SM 53	720	VF	Gl						2	1	1	1						5	4
SM 32	730–750	F	F							1	1							2	2
SM 31	740	VF	Gl		3		1					1						5	3
SM 78	750	F	F								1							1	1
SM 60	800–810	MC	F		11				3	6	1	1				1		23	6
SM 61	820	VF	Gl		6													6	1
SM 41	880	MC	F		5					5			12		14		2	38	5
SM 109	1300	F	Gl	1														1	1
		Totals		26	235	37	2	3	5	33	18	6	49	37	30	1	24	506	

Zoogeographical and faunistic considerations

The bryozoan faunas of the outer continental shelf and slope, in most of the world's seas, are little known. Early systematic works rarely discriminate between the slope faunas and those of the shallower shelf waters, or between the slope and the abyssal depths beyond 2 000 m. However, it is becoming apparent that the composition of slope and deep shelf bryozoan faunas, as with other animal groups (Briggs 1974: 360), may differ markedly from those of both shallower and deeper waters.

Recent interest in the bryozoan faunas of the continental slope between 200 and 2 000 m has been largely focused on the North-eastern Atlantic and the *Meiring Naude* collections presented a valuable opportunity for comparison. Such conclusions as have been reached in recent works are still tentative and subject to modification as further data accumulate. The most significant result of the present survey, namely the astonishing number of undescribed species, is both an aid and a hindrance to current discussion. The works of D'Hondt (1974, 1975*a*, 1975*b*, 1977) and others have shown that even in the well-studied North-eastern Atlantic waters a significant proportion of new species may be expected from samples collected along the continental slope. The complete lack of exploration of the South African slope is demonstrated here by the discovery of a quite unknown fauna. However, the preponderance of undescribed species makes it difficult to assess their importance to current ideas, as no comment may be made on their geographical and bathymetric ranges, beyond that revealed by the survey.

A further problem is the relative paucity of information on the bryozoan benthos of South African coastal waters, compared, for example, to those of Europe and North America. It is essential to have a sound background in the vertical and geographical distribution of coastal and shelf species before the significance of deep water records may be considered. For example, from present understanding of the vertical distribution of colony types, and of certain taxonomic groupings, it seems unlikely that the species of *Adeonella* recorded here reflect their actual bathymetric distributions within the series of samples available. It is probable that all four species are here at the lower limit of their vertical ranges. In considering the composition of slope faunas it is necessary to be able to isolate different components, demonstrating which may be shelf species, declining steadily with depth; which are perhaps truly abyssal species, at the upper limits of their range; and which species represent the indigenous slope fauna. For the most part this approach is not possible here, although some information may be gleaned from the known distributions of the minority of previously described species. It is perhaps permissible, also, for some of the new species, to draw analogies with related species in better known regions.

In Table 4 the 22 previously described species are listed, together with their known geographical and bathymetric ranges, in some cases taken from specimens in the British Museum (Natural History). The bathymetric range of specimens from the *Meiring Naude* stations which were collected alive is also given for

Table 4

Geographical and bathymetric ranges for 22 species of Bryozoa.

	Depth range in m: *Meiring Naude* living colonies	Depth range in m: Previously known	Geographical Distribution: South Africa	East Africa	South Indian Ocean	Indo-West-Pacific	South Atlantic	North-east Atlantic	Mediterranean
D. umbellata	—	8–130 (50–207)	(×)	(×)				×	×
S. roulei	376–1 300	1 900–2 330						×	
H. implicata	376–880	200–3 700						×	
N. cylindracea	—	144–270			×				
L. inornata	1 000	135–270			×				
E. quadrata	376–680	50–1 668		×	×				
C. magna	680–700	1 900–4 850		×	×		×	×	
P. bicornis	688–1 200	469–3 500				×			
F. philomela	—	90–135			×				
F. marginata	—	90–270	×		×				
G. polymorpha	680	71–265	×						
A. coralliformis	—	270–750	×						
B. submucronata	800–810	567–1 158				×	×		
B. longicaulis	740	1 158–2 796				×			
C. protrusum	400–450	10–18		×		×			
S. hexagonalis	550	48	×						
A. latirostris	376–450	30–310	×	×		×			
A. inarmata	720–810	732		×					
B. murrayi	376–810	805		×					
L. pyriformis	376–688	310		×					
C. africana	376–880	101	×						
I. atlantica	550	6–300						×	×

comparison. Most of the small, setoselliniform, lunulitiform and conescharelliniform colonies are here reported from depths well within their known vertical range (*Heliodoma*, *Anoteropora inarmata* and *Batopora*) or from deeper waters (*A. latirostris*, *Lacrimula* and *Conescharellina*). *Setosellina* occurs from a very wide range, slightly shallower than that reported before. *Meiring Naude* results further strengthen the contention that these small animals are particularly adapted to life on the soft, unconsolidated sediments of the slope, and that the latter four genera may be restricted to a fairly narrow range of depths. *Discoporella umbellata* is essentially a shallower-shelf species, although the South African population, which differs in some characters from the typical form, is known from deeper water than specimens from the Mediterranean and North-eastern Atlantic (Table 4). *D. umbellata* is associated with coastal sandy deposits, but the present material was dead and had been transported far beyond its normal vertical limits. Several species occurred at depths greater than their known range. In the case of *Leiosalpinx inornata*, *Gigantopora polymorpha*, *Smittina hexagonalis*, and the shallower record of *Cleidochasma protrusum* living colonies were collected, but several others were represented only by fragments (*Notocoryne cylindracea*, *Figularia philomela*, *Flustramorpha marginata*), suggesting that the records reflect transported debris. Both *Columnella magna* and *Bifaxaria longicaulis* normally occur in deeper waters than was sampled by the present survey.

Of the newly described species, few show any immediate evidence of restricted vertical distributions: most occurred at more than one station, and many were distributed over a considerable depth range. However, *Escharoides distincta* was represented by fragments only at the two shallowest stations, suggesting that it might prove to be a shelf species at the lower limit of its distribution. *Sertella bullata* was likewise recorded only at the two shallowest stations, and the two species of *Reteporellina* were recorded also at two stations, at 400 m and 880 m. Much of the material of the latter two species was fragmentary; both of these genera are more usually associated with the outer shelf (although slope species are known) and the deeper records, again, probably represent transported material. The same comments may be applied to the two species of *Cellaria*. Conversely, *Turbicellopora protensa* was collected as living material from the same two stations, and this genus is most often found in shallow coastal waters. The genus *Notoplites* is widespread around the world, and in the North-eastern Atlantic is represented by several deep shelf and slope species (Hayward & Ryland 1978).

The virtual absence of Ctenostomata has been remarked upon before. It might be added here that, in the North-eastern Atlantic, significant numbers of deep benthic ctenostomes become evident only below 1 000 m.

Table 1 shows the number of species recorded for each of the stations, and exemplifies the usual decline in species diversity with depth. The unexpectedly high number of species (18) recorded from station 41 includes many, discussed above, which were apparently dead or recorded only as fragments. Only six species (*H. implicata*, *N. cervicornis*, *C. magna*, *T. protensa*, *B. nola* and *C. africana*) were represented by specimens which may be inferred to have been alive when collected. It is interesting to note that the total fauna at each station would have been far lower without the small, free-living or rooted, species (*Anoteropora*, *Batopora* etc.). Species diversity in Bryozoa is, generally, largely a function of the availability of hard substrata and, consequently, niche diversity (Eggleston 1972). Yet, a very high proportion of this fauna was essentially independent of hard substrata, except for the smallest particles.

On the basis of present knowledge it is likely that the Bryozoan fauna of the continental slope of South Africa represents an admixture of shelf species, with varying lower vertical limits, and a distinct component of slope species, whose vertical ranges may or may not be completely encompassed by the range of depths sampled here. But, with the exception of *Batopora*, *Anoteropora*, *Lacrimula* and *Conescharellina*, it is not possible to separate the two clearly until further information becomes available.

The various limitations discussed above must be considered also when discussing the geographical distribution of the species. The known geographical ranges for the described species are given in Table 4. The first three species listed, and *Idmidronea atlantica*, are reported for the first time remote from their presently known centres of distribution, and represent interesting new records. Four species, *G. polymorpha*, *S. hexagonalis*, *A. coralliformis* and *C. africana*, are still known only from South African waters, and several others are previously known only from the South Indian Ocean (from Kerguelen, for example), or from east Africa. Generally, the Table supports the opinion that the South African marine fauna represents the western fringe of the Indo-West-Pacific zoogeographical realm. Briggs (1974) summarizes earlier works which demonstrate that the east South African fauna constitutes a distinct zoogeographical province, largely influenced by the southward-flowing, warm Agulhas current, and with a high degree of endemism. To a certain extent these collections support this suggestion. Bryozoan faunas to the south are generally well known, with considerable published data on the islands of the southern, cold-temperate Indian Ocean, and the Southern Ocean generally; yet only six of the species in this collection have been reported from these regions. To the north, Waters (1909, 1910, 1913, 1914) reported on the Bryozoa of the Sudan, east Africa and Zanzibar, but again none of the species described by him were found in this survey. It has been emphasized above that these regions are still under-studied, yet it might have been expected that a few of the species described by Waters would have been found, especially considering the common factor of the Agulhas current. Further research will no doubt result in broader geographical distributions being established for many of the species described in this paper, but it is probable that a significant proportion will prove to be endemic to this region.

SUMMARY

A total of 51 species of Bryozoa has been found in a collection from 17 *Meiring Naude* stations, ranging in depth from 376 to 1 300 m. Nearly half the species described, 23 in total, are considered to be new. In view of the large number of hitherto undescribed forms found recently in the deeper shelf and slope benthos of the North-eastern Atlantic, this high proportion of new forms is not unexpected, and it is interesting that it is similar to the proportion reported for other groups from the *Meiring Naude* collection (see Griffiths 1977; Millard 1977; Kensley 1978).

The greatest diversity of bryozoans was found from 376 to 550 m, although several species are inferred to have been transported from shallower waters. Some deep-water forms (e.g. *Setosellina roulei*, *Columnella magna* and *Bifaxaria longicaulis*) have previously been reported from much greater depths, but the lower limits of bathymetric range of others (e.g. *Leiosalpinx inornata*, *Cleido-*

chasma protrusum and *Conescharellina africana*) have been considerably extended by these collections. Specimens which were alive when collected have provided valuable information on both early astogenetic stages and later astogenetic changes of colonies (e.g. *Tricellaria varia*, *Cellaria paradoxa* and *Tessaradoma circella*). Many colonies, particularly those capable of direct colonization of fine sediments, also showed evidence of rhizoid systems for anchorage. The demonstration of rhizoids in *Anoteropora*, *Batopora* and *Lacrimula* allows stronger inferences to be made about the environmental parameters of similarly constructed colonies over a wide range of time and space (see also Cook & Lagaaij 1976). The discovery of a setoselliniform cribrimorph species (*Inversiscaphos setifer*) illustrates the remarkable similarity of adaptations of unrelated genera which are a response to the 'sand fauna' environment. The adaptations of growth form of *Turbicellepora protensa* are also very interesting, although as yet less understood. The abundance of minute colonies is a direct result of the detailed examination of bottom sediments, and these collections have provided large numbers of some 'rare' species (e.g. *Heliodoma implicata*) which have hitherto been known from a few colonies only. Relatively large quantities of delicate, erect branching species (e.g. *Bugulella australis* and *Eupaxia quadrata*) were also present, the last named being remarkable for its brilliant red pigmentation, which persists in preserved specimens. It is possible that the deeper shelf fauna of south-eastern Africa may prove to include a significant proportion of endemic forms. Generally, however, the area appears to constitute the extreme westerly limit of the Indo-West-Pacific faunal realm (see also Clark 1977, but compare Millard 1978). As with the Hydroida (see Millard 1977), however, a few of the Bryozoa have previously been reported only from the North-eastern Atlantic (e.g. *Setosellina* and *Heliodoma*), and this indicates both how much information has been gained from study of these collections, and how much further work remains to be done on the deeper shelf and slope faunas of the world's seas.

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